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(54) Automatic machine for manufacturing, checking, filling and capping bottles made of thermoplastic material

(57) The parisons (P) manufactured by an extrusion group (1,1") are gripped between the mould and the counter-mould (S,S') mounted, together with the associated actuating mechanisms, on a carriage (19) which, after receiving the parisons, moves into a blowing station (Z1) for the formation of the bottles which then remain suspended from the nozzles of this station. By means of a set of three self-centring closing and opening grippers (P1, P2, P3), the groups of bottles are then transferred from the said blowing station to a sprue-removal and mouth-calibrating station (Z2), to a quality control station (Z3) and then to a filling station (Z4). By means of a fourth self-centring gripper (P4) with an independent movement the filled bottles are finally transferred into an end capping station (Z5). A conveyor (59) which collects together and removes all the production waste is provided underneath the various work stations which are aligned with each other. A single electronic unit (178) manages automatic control of the machine. In intermediate positions, two cranes (173, 175) are provided for facilitating the maintenance and size-changing operations.

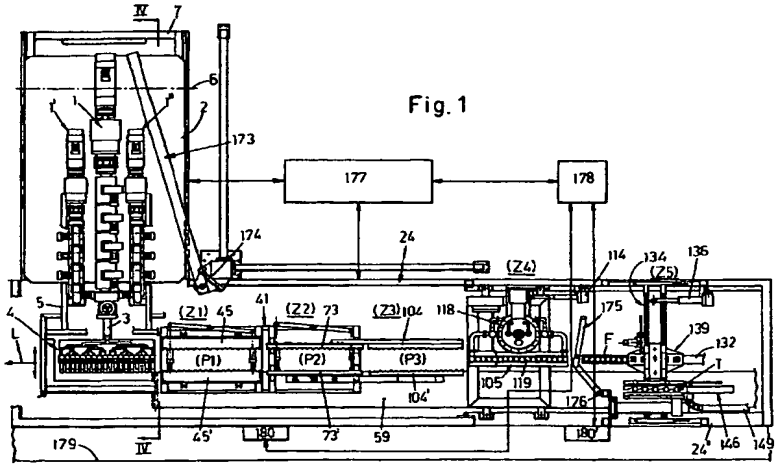

Fig. 1

EP 0 950 606 A2

Description

[0001] The invention relates to an automatic machine for manufacturing, checking, filling and capping plastic bottles. At present plastic bottles are manufactured in locations which are often different from the locations of use and, in any case, after manufacture, they are stored and only subsequently are they taken out of storage and supplied to the filling and capping machine. During the storage, transportation and storage-removal stage, many bottles are damaged and create problems during the subsequent stage of use. Storage, removal from storage and in particular transportation of the bottles are operations which increase significantly the costs of packaging the product which is introduced into the said bottles.

[0002] The machines of the known type which fill and cap plastic bottles are often very fast rotating machines which must be combined with units for supplying the bottles removed from the storage locations in loose form and units for checking the suitability of the bottles themselves, which must be interfaced with each other and with the filling machine, resulting in particular problems with regard to control of the automatic operation of the entire system, in particular during the start-up stages. In known systems, minor operating problems in a unit located upstream result in stoppage of the entire plant, thereby further increasing the packaging costs. In known plants, discarding of the defective products is performed downstream of the said plants, whereas in the connection zones between the various working units of the plant it is extremely difficult to provide the possibility of discarding defective bottles and allowing the downstream stations which have received properly formed or properly filled bottles to continue operating. The known art is therefore characterized by the use of plants which are very fast, but which are often inactive due to operating defects, and this also has a negative effect on the packaging costs.

[0003] The invention intends to overcome these and other problems and drawbacks of the known art by means of a machine with relatively small dimensions which must be periodically supplied only with the plastic material necessary for the manufacture of the bottles, the liquid to be packaged and the caps and which is able to manufacture automatically the plastic bottles and, if necessary, label them where required, remove from them the sprues resulting from the moulding cycle, calibrate their necks, check their suitability for use, fill them, checking that filling is properly performed, and finally cap them, checking for the correctness of the closure. The machine according to the invention will therefore supply full and capped bottles and will also dispose of the processing waste and the defective bottles which will be ground up and recycled. The machine according to the invention is of the linear type, with an intermittent working cycle, with the various stations located one after another and in a condition ensuring maximum accessibility for adapting them to variations in the size of the bottles. The extruder is preferably positioned perpendicularly at the front end of the machine, where the multiple-form mould and counter-mould group operates and means are provided for ensuring that, when this group closes around the parisons and the latter are cut, the extruder which remains active for the manufacture of new parisons, is raised, while the mould and counter-mould group moves one step and is brought into alignment with the blowing station which is lowered and inserts its nozzles into the group in question, for the formation of the containers which remain trapped with their mouths in the nozzles of this station. Then the mould/counter-mould group opens and is displaced so as to return into the station for gripping new parison sections, while the extruder returns in synchronism into the lowered position. The carriage which carries the mould and counter-mould group is connected to a following carriage which carries three successive grippers with a self-centring movement, which cyclically transfer the groups of thermoformed bottles from the blowing station to the following calibrating and sprue-removal station and then from this station to the following station for checking sealing and the compression strength of the said bottles and then from this station to the following filling station. In synchronism, a fourth self-centring gripper, which is mounted on its own carriage, removes the bottles from the filling station and transfers them into the capping station from where the full and sealed bottles will then be conveyed away by means of a conveyor.

[0004] All the operating stations of the machine, including the mould and counter-mould group, are mounted in cantilever fashion on a support shoulder opposite the side of the machine where the machine operator normally stands, so as to allow maximum accessibility during the inspection and size-changing operations. A conveyor belt is provided underneath the various stations, from the blowing station to the end capping station, and collects the sprue and the production waste and discharges it at the same end of the machine from where the full and capped bottles emerge. At two intermediate points along the machine, respective jib cranes are provided for rapid replacement of the components of the machine itself during the maintenance or size-changing operations. The whole machine is preferably enclosed in a housing and may be designed to operate in a controlled-atmosphere environment, useful for the packaging of products of any type, from aggressive and volatile products to food products or cosmetic or pharmaceutical products. A single electronic control unit interacts with the processors of the various working units and manages automatic operation of the entire machine in accordance with a predefined program. The machine is characterized by operating speeds which are slower than those of plants of the known type, said speeds being offset partly by the high number of bottles produced during each cycle, and basically differs from the known plants owing to the sub-

stantial lack of operating defects since, as a result of the abovementioned slow speeds, the individual operations may be performed with a high degree of precision and the bottles may be transported from one station to another with positive control. For all of the above reasons, the machine in question is competitive compared to the machines and plants of the known type.

[0005] Further characteristic features of the machine according to the invention and the advantages arising therefrom will emerge more clearly from a preferred embodiment thereof illustrated purely by way of a non-limiting example in the figures of the accompanying sheets of drawings, in which:

- Fig. 1 is a schematic top plan view of the machine;
- Figs. 2 and 3 show an elevation view of a first and a second section of the machine on the side where the operator usually stands;
- Fig. 4 shows the front end of the machine, partially sectioned along the transverse line IV-IV of Figure 1;
- Fig. 5 shows a top plan view of the carriage which carries the first three self-centring closing and opening grippers, for transfer of the groups of bottles between the first four operating stations of the machine;
- Figs. 6 and 7 show a side elevation view of the parts of the carriage according to Figure 5 and respectively show, of this group, the side facing the operator and the opposite side;
- Figs. 8 and 9 show further details of the means according to Figure 5, respectively sectioned along the lines VIII-VIII and IX-IX;
- Figs. 10, 11, 12 and 13 show a side elevation view, with parts sectioned, of the blowing station, the station for performing the sprue-removal and mouth-calibrating operations on the bottles, the station for checking the quality of the bottles and the station for filling the said bottles;
- Fig. 14 shows a top plan view, as shown in Figure 1, of further details of the bottle capping station;
- Fig. 15 shows further details of the station according to Figure 14, partly transversely sectioned along the line XV-XV;
- Fig. 16 shows, on a larger scale, details of the part of the station according to Figure 14 intended for supplying the caps.

[0006] With reference firstly to Figures 1 to 4, it can be seen that the extruder or the group of extruders 1, 1', 1" as in the example in question, intended for the manufacture of parisons with several co-extruded layers, is mounted together with all the necessary adjusting systems on a sturdy platform 2 from which the said extrusion group projects with the discharge mouth connected by means of the pipes 3 to the co-extrusion head 4 which produces several adjacent and aligned parisons P, as can be seen from the false view of Figure 1, and which is removably attached to the structure 5 in turn fixed in cantilever fashion to the said platform 2. This platform is supported, with the possibility of performing a "pitching" movement about a transverse and intermediate axis 6, by a sturdy support structure 7 in the form of a gantry, on which a servo-control unit 9 is pivotably mounted at 8, said unit being in turn hinged at 10 with said platform 2, so as to impart to the latter the necessary pitching movement (see below) which results in the raising and lowering of the co-extrusion head 4, as shown in Figure 4 in continuous lines and in broken lines and as shown by the curved arrow 11 centred about the pivot point 6. The gantry structure 7 may have, arranged underneath it, the control unit or units 12 which operate all the machine actuators operating by means of fluid pressure.

[0007] The parisons P which are discharged from the extrusion head 4 are fed between a mould and a counter-mould S,S' mounted on slides 13,13' with a self-centring movement which, in the example in question, form part of an apparatus protected by a separate patent application in the name of the same Applicant, in which the slides are mounted slidably on suitable guide means, not shown, are interconnected by a rack-and-pinion synchronization device 14 and are actuated by respective double-acting hydraulic cylinders 15,15' hingeably joined with their bodies at 16,16' to the top forked end of respective substantially vertical levers 17-17' which in turn are pivotably mounted in between at 18,18' on a support carriage 19 and are interconnected at the bottom end by means of reaction struts 20. The carriage 19 slides on a set of three straight guides 21, 22, 23, the first of which is fixed onto a vertical shoulder 24 partly formed by the front upright of the gantry structure 7 and extending over a section of suitable length for supporting other machine components, while the other two guides are fixed onto a horizontal base structure 25. The carriage 19 is connected to the end of the rod of a horizontal hydraulic cylinder 26 which is fixed with its body to the said shoulder 24. When the carriage 19 is opposite the extrusion group, the rod of the cylinder 26 is in the fully extended position on the side where the said carriage is located. During this stage, the mould and counter-mould group S,S' is open, as can be seen from Figure 1, and the extrusion head 4 is in the lowered position. When, upon operation, the mould and counter-mould group is closed so as to grip the parison sections P arranged between them, the known cutting means which separate the said parison sections are activated in synchronism, the servo-control unit 9 is activated so as to raise the extruders, and the carriage 19 moves by a predetermined amount so as to transfer the mould and counter-mould group into the nearby blowing station Z1 which is described below also with reference to Figure 10. If the bottles must be labelled, to the left of the mould and counter-mould group, as indicated by the arrow L in Figure 1, labelling means of the known type may be provided, for example as described in Italian

Patent No. 1,260,296 in the name of the same Applicant, which in synchronism insert into the cavities of the mould and counter-mould, when open, labels which are pre-treated with thermal adhesives and which are retained by means of suction in the said cavities and will adhere to the bottles when they are formed.

[0008] From Figure 10 it can be seen that a slide 29 is mounted, by means of gib plates 27 and with a horizontal screw/female-thread adjusting device (Fig. 2), on a plate 24' fixed onto the abovementioned shoulder 24, said slide 29 carrying, fixed in cantilever fashion, a structure 30 with a pair of vertical guides 30' on which the blowing head 31 slides, said head being provided at the bottom with vertical and known nozzles 32 which are axially hollow and connected to the distributor 33 with the blowing pipes. The head 31 is connected directly, as can be seen in Figure 10, or via a spacer 34, as can be seen from Figure 2, to the bottom end of the rod of a hydraulic cylinder 35 which is fixed with its body onto the structure 30 and is provided with a known device 36 which allows precise adjustment of the heightwise rest position of the station in question, where the nozzles 32 are retracted relative to respective extractors 37 supported by a vertical-adjustment structure 38 mounted on the slide 29.

[0009] When the carriage 19 together with the mould and counter-mould group reaches the station Z1, in synchronism, activation of the cylinder 35 is performed so as to cause the downward movement of the head 31 and insertion of the nozzles 32 into the bladders of thermoplastic material which are gripped in the various adjacent cavities of the said group S,S, and, in synchronism, the nozzles blow air into the said bladders so as to inflate them and cause them to cling to the said cavities, such that said bladders assume the shape of the bottle, as indicated for example by F in Figure 10. Once formation of the bottles has occurred, the mould and counter-mould group S,S' is opened and, while the bottles themselves remain suspended from the nozzles 32 of the blowing head which are suitably formed for this purpose, the cylinder 26 is activated so as to cause the carriage 19 to co-operate again with the extruders, in order to repeat a new working cycle. If, due to problems, a bottle should remain suspended from the associated blowing nozzle, the said bottle falls onto a rectilinear conveyor 59 (Figs. 2, 3) which extends along the whole length of the machine, so as to collect all the production rejects and waste, as explained further below.

[0010] With reference also to Figure 5, it can be seen that the support shoulder 24 has, fixed to it in cantilever fashion, a pair of horizontal guides 39 which slidably supports a carriage 40 which, with its arm 40', is hingeably joined to the other end of the rod of the cylinder 26, such that the said carriage performs movements which are synchronized with and in the same direction as those of the said carriage 19. With reference also to Figures 6, 7 and 8, it can be seen that the carriage 40 has, fixed to it in cantilever fashion, a horizontal rectangular-shaped frame 41 which is divided into two equal parts by a middle cross-piece 41'. Slides 43,43' are mounted on said cross-piece and on the parallel side of the frame 41 which is directed towards the carriage 19, via guide and slide groups 42,42' which are straight and parallel with respect to these sides, said slides being arranged edgewise and parallel to the carriage 40 and having, fixed onto them, by means of uprights 44,44', the comb-shaped jaws 45,45' of a first gripper P1 which are located at different heights and have a shape suitable for gripping the bottles F of the station Z1, for example along a bottom section or along a top section. From Figures 5 and 8 it can be seen that the slides 43,43' are connected together at the ends by fluid-pressure cylinders 46,46' and that the displacement of these slides is made self-centring owing to the hinged connection of their said ends to tie-rods 47,47' which are in turn hingeably joined to the ends of a horizontal lever 48 which is pivotably mounted in the middle on a vertical shaft 49 supported by the frame 41. When the carriage 19 together with the mould and counter-mould group cooperates again with the extruders, the jaws 45,45' of the gripper P1 assume the open position in the blowing station, laterally with respect to the bottles F retained by the nozzles 32 according to Figure 10 and in synchronism the said jaws are closed so as to grip the said bottles. In phase sequence, the blowing head together with the nozzles 32 is raised and the said nozzles are extracted from the bottles and leave them free, also owing to the action of the extractors 37 which prevent raising of the bottles. When the carriage 19 together with the mould and counter-mould group is then transferred into the blowing station, the gripper P1 with the bottles is transferred into a following station Z2 which performs upper and lower sprue-removal and calibrating of the mouth of the bottles which are temporarily held by the said gripper P1.

[0011] From Figure 8 it can be seen that the uprights 44,44' which carry the jaws of the gripper P1 have, mounted on them, opposite and known groups 50,50' which are operated by respective cylinders 51,51' and which, in the station Z2, are activated so as to perform removal of the sprue from the bottom of the bottles. Still from Figure 8 it can be seen that removal of the sprue from the top of the bottles is performed by a unit which is located in the station Z2 and which comprises a comb-shaped cutter 52 mounted on a slide 53 actuated by a cylinder 54 which, together with the guide of the said slide, is mounted on a vertical slide 55 slidable on a guide 56 supported by the fixed support plate 24' already considered. The heightwise position of the upper sprue-removal device 52 is adjustable with precision by means of the screw/female-thread adjusting device 57 and may be fixed in the desired position using tightening means 58. The waste produced by the sprue removal from the top and bottom of the bottles falls onto the conveyor 59 (Figs. 2 and 3) which continuously travels underneath the stations in question and is dis-

charged from the same end of the machine from where the full and capped bottles emerge. From Figure 11 it can be seen that the station Z2 comprises a set of vertical and cylindrical punches 60 with a tapered bottom end having dimensions which are proportional to those of the mouth of the bottles and cooled by the internal and forced circulation of a liquid supplied by the header 61 by means of which the said punches are mounted on a slide 62 slidable on a vertical guide 63 in turn fixed onto a further slide 64 which is guided with the possibility of vertical displacement, also by means of the screw/female-thread adjusting device 65, on a plate 66 which is fixed onto the vertical support plate 24'. The slide 64 has, mounted on it in cantilever fashion, an arm 67 which supports the body of a fluid-pressure cylinder 68 connected via the rod to the slide 62 with the punches. Fluid-pressure cylinders 69 are fixed, with their bodies, underneath the header 61 and with their rod actuate the extractor 70 associated with each punch 60. The operating mode of the station Z2 is simple and obvious. At the start of each cycle, the rods of the cylinders 68 and 69 are in the retracted position and, when the bottles F have been positioned in this station, the cylinder 68 is activated so as to extend and insert the punches 60 into the mouths of the bottles which are still hot and held by the jaws 45,45' of the gripper P1 which, in synchronism, then opens and sets itself to return into the blowing station Z1, in order to grip new thermoformed bottles. The bottles engaged by the punches 60 remain suspended from the said punches owing to cooling and contraction of the material from which they are made and, owing to said co-operating engagement, the mouths of the bottles are all perfectly calibrated. If, owing to the presence of imperfections in the mouth, a particular bottle should not remain attached to the associated punch 60, the said bottle falls and is collected by the removal conveyor 59.

[0012] From Figures 2, 3, 5, 6, 7 and 9 it can be seen that slides 72,72' which are parallel to one another and with respect to the carriage 39 are mounted on the remaining right-hand part of the frame 41 via straight guide and slide groups 71,71', said slides 72,72' having, mounted on them, the comb-shaped jaws 73,73' of a gripper P2 which alternates with the gripper P1 for gripping of the bottles in the station Z2. The jaws of the gripper P2 are also made to perform a self-centring movement by means of a pair of fluid-pressure cylinders 74,74' and a pair of tie-rods 75,75' which are connected to the said slides and to the opposite ends of a lever 76 which is pivotably mounted in the middle, at 77, on the frame 41. From Figures 7 and 9 it can be seen that the jaws 73 are associated with the slide 72 by means of uprights 78, while the jaws 73' are associated with the slide 72' by means of uprights 78' and vertical slide/guide groups 79,79' and a fluid-pressure cylinder 80, with which the said jaws 73', which are normally in the high position and facing the jaws 73, may if necessary be lowered, for the purposes stated further below. When the gripper P1 is transferred into the blowing station Z1 for gripping of the bottles formed during the preceding cycle, the gripper P2 moves into the station Z2 and, during this stage, opto-electronic sensors 200,200' mounted on the left-hand end of the jaws 73 of this gripper (Figs. 7 and 9), above and below these jaws, scan the row of bottles positioned in the said sprue-removal and calibrating station Z2 and, by means of an electronic apparatus with suitable software, detect the presence of any residual sprue above and below the said bottles, indicating to the control unit the position of any defective bottles, such that said control unit, before the jaws of the gripper in question close, is able to effect the selective discarding of any defective bottles, with activation of the associated extractor 70 which extracts the said bottles from the associated calibrating punches 60. After elimination of any defective bottles, the jaws 73,73' of the gripper P2 close and then the punches 60 of the station Z2 are raised and the associated extractors 70 are lowered so as to prevent the bottles from tending to follow the punches which are extracted and therefore prevent the said bottles from being damaged as a result of contact against the gripper P2 holding them. In phase succession, while a group of bottles is transferred from the station Z1 to the station Z2, the group of bottles which underwent calibration in the station Z2 is transferred by the gripper P2 into a following station Z3 which is now described with reference to Figures 2 and 12.

[0013] When the gripper P2 reaches the station Z3, it arranges the bottles F above and at a very small distance from the horizontal plane of a bench 81 supported in cantilever fashion by the supports 82 which are fixed to a slide 83 which is guided vertically on the plate 24' and the heightwise position of which may be adjusted by means of a screw/female-thread group 84. From Figure 6 it can be seen that the supports 82 are arranged at the right-hand end of the bench 81, while from Figure 7 it can be seen that the uprights 78 supporting the jaws 73 of the gripper P2 are arranged at the left-hand end of this gripper such that the jaws 73,73' are able to be positioned in the station Z3 without interference occurring between the said parts 82 and 78. The shape of the support surface of the bench 81 may vary according to the shape of the bottles F. Holes 85 are formed in this support surface, being at least one in number for each bottle which is transferred onto this surface, and each hole is connected by means of the circuit 86 to a suction source 87 via suitable intercepting means, not shown. Suction into the holes 85 may, for example, be created with ejectors of the commercially available type. When the bottles Z3 are positioned in the station Z3 and the jaws of the gripper P2 open, the bottles themselves touch the support surface of the bench 81 and are firmly held on it by the suction exerted in synchronism by the holes 85. A bar 88 is provided above the bench 81 and parallel to the latter, said bar being supported by a bracket 89 which is removably fixed onto a slide 90 which is guided vertically on the plate 24' and the

heightwise position of which is adjustable vertically by means of the screw/female-thread group 91. The bar 88 has fixed underneath it, by means of their bodies, double-acting fluid-pressure cylinders 92 which are identical and vertical and the rods of which have, mounted on them, a bell-shaped body 93 which is provided with an axial cavity 94 which slidably houses with radial play a mushroom-shaped probe 95 which projects at the bottom from the said cavity and which with its head 95' is pushed by a spring 96 so as to close the top end of the said cavity 94. The bottom side of the bell member 93 is lined with a layer 97 of elastomeric material. The cavity 94 is thus normally open downwards and is instead closed upwards and two holes are provided in the middle part of this cavity, one of said holes being connected to a source 98 for the delivery of air at a correct pressure value, while the other hole is connected to a unit 99 able to emit an electric signal which is proportional to the detected pressure and which, by means of an electronic circuit not shown, is compared with predefined values. The station Z3 thus formed operates in the following manner. After the bottles have been transferred into the station Z3 and when they are still held momentarily by the gripper P2, extension of the rod of the cylinders 92 is performed so that the probes 95 enter into the bottles and the insert 97 of the bell members 93 comes into contact with the mouths of the bottles themselves, so as to close them and subject them to a compression of a predetermined value, while in synchronism the said gripper P2 opens. Magnetic relays 100-100' are mounted on the body of the cylinders 92, being arranged at a distance from one another which is slightly greater than the distance existing between the insert 97 in the rest condition and the mouth of the bottles, precisely so that if the bell members 93 descend with a predefined travel movement, which subjects the bottles to a predetermined compression and if the bottles themselves react correctly to this compression, this condition is detected by the relay 100' connected via the group 99 to a control unit, not shown, which detects the suitability of the tested bottles. If, on the other hand, the abovementioned condition does not occur, so that the piston of the cylinder 92 does not arrive as far as the relay 100' or exceeds it, the control unit considers that the tested container is not suitable for use and arranges for elimination thereof as explained further below. After the downwards movement of the bell members 93, checking of the seal of the bottles is activated by introducing air into the said bottles through the circuit 98 and detecting whether the pressure is maintained after a predefined time, by means of the device 99. If the predefined pressure is not maintained, for example owing to holes or microscopic apertures in the tested bottle or owing to a lack of a sealing action of the insert 97 against the bottle mouth or due to raising of the probe 95 as a result of interference with sprue on the top of the bottle, the checking unit to which the device 99 is connected arranges for discarding of the defective bottle.

From Figures 1, 2, 6, 7 and 9 it can be seen that the parts which support the jaws 73,73' of the gripper P2 support in cantilever fashion stringers 103, 103' which carry the uprights 204,204' of the comb-shaped facing jaws 104,104' of a third self-centring closing and opening gripper P3. When the carriage 40 is in the retracted position as can be seen in Figure 2, the gripper P3 is arranged with the jaws open in the aforementioned checking station Z3, so as to grip the bottles which have been tested and considered suitable for use. If, after the abovementioned checking step, some of the tested bottles must be discarded, the cylinder 80 according to Figures 8 and 9 is lowered so as to lower the jaws 104' of the gripper P3 underneath the support surface of the bench 81 and the nozzles 101 associated with the jaws 104 are selectively operated so as to remove from the said bench defective bottles, the pneumatic connection of which to the bench 81 is selectively neutralized, following which the jaws 73' and 104' return into the high working position. The discarded bottles, by means of chutes 102 and the like not shown, are conveyed onto the removal conveyor 59.

[0014] When the gripper P2 closes in order to grip the bottles in the station Z2, the gripper P3 closes in order to grip the bottles tested in the station Z3, following which suction in the bench 81 is deactivated. When the carriage 40 is made to move forwards by one step, in order to insert new groups of bottles into the stations Z1, Z2 and Z3, the grippers 104,104' transfer the tested bottles into the station Z4 which performs filling of the said bottles and is now described with reference to Figures 1, 3 and 13.

[0015] From the said figures it can be seen that the station Z4 comprises a straight horizontal bench 105 which supports adjacent weighing units 106, being of a number and having an arrangement such that the associated pan 107 of each unit, when the gripper P3 is opened, receives one of the bottles transported by this gripper P3. The bench 105 is attached in cantilever fashion at its left-hand end (as viewed in Figures 1 and 3), by means of a support 108, to a slide 109 which slides on a vertical guide 110 fixed onto a support structure 111 in turn fixed to the support shoulder 24 and the heightwise position of the said slide may be adjusted, upon variation in the size of the bottles, by means of a screw/female-thread adjusting device 112 which is fixed to the frame 111. The cantilever arrangement of the bench 105 is required in order to allow positioning, in the station Z4, of the fourth independent gripper (see below) which must subsequently remove the bottles from this same station and transfer them into the following station Z5. The shoulder 24 has, fixed to it, via a first horizontal slide/guide group 113, with associated adjusting device 114 (Fig. 1), and a second vertical slide/guide group 115, with associated adjusting device 116, a unit 117 which is designed for the controlled delivery of the liquid product to be packaged in the bottles and which comprises for example a liquid storage

tank 118 connected to a set of delivery nozzles 119 which are aligned with each other, directed downwards, each aligned with a bottle F located on the scales 106 and controlled by respective proportional solenoid valves 120. When the gripper P3 arrives inside the station Z4, the bottoms of the bottles F are located at a very small distance from the surface 107 of the scales and the mouths thereof are located at a small distance away from the closed nozzles 119. The gripper P3 opens so as to deposit the bottles on the scales which detect the tare of the bottles themselves, after which the electronic unit which controls operation of the machine, causes opening of the nozzles 119 following a procedure such that the bottle remains closed, the liquid does not form any foam, filling of the bottles is performed within the time period predetermined by the machine cycle and the predetermined quantity of liquid enters into the bottles. It is obvious that the scales act as sensors for detecting the presence of the bottle and that, when no bottle is present, they prevent opening of the associated nozzle 119. The deactivation of the solenoid valves 120 and the consequent closing of the nozzles 119 is effected by the scales 106 following a procedure such that the tail-end of the liquid delivered by the said nozzles also helps form the predefined working weight. Finally, means, which can be easily realized by persons skilled in the art, are envisaged in order to ensure that the opening procedure of the nozzles 119 is automatically adjusted according to the weight detected by the scales 106 at the end of the bottle filling cycle.

[0016] When filling has been completed, the bottles are gripped by the facing jaws 121,121' of a gripper P4 and transferred into the following capping station Z5 which is now described with reference to Figures 1, 14, 15 and 16. The jaws of the gripper P4 which are also in the form of combs and designed to grip the filled bottles, as schematically shown in Figure 15, are supported by slides 122,122' which are mounted with the possibility of a self-centring movement, by means of fluid-pressure cylinders and rack-and-pinion synchronization devices, not shown, on a carriage 123 which is able to slide on a horizontal guide 124 oriented in the direction of the length of the machine and long enough to cover the whole of the station Z5 and the station Z4 in which it is arranged underneath the bench with the scales. The guide 124 is supported by a structure 125 which is fixed in cantilever fashion on a slide 126 slidable on a vertical guide 127 fixed onto the support shoulder 24 to which there is fixed a screw/female-thread device 128 which is connected to the said slide 126 and by means of which it is possible to adjust the heightwise position of the gripper P4 upon variation in the size of the bottles F. The structure 125 has, fixed to it in a parallel manner and at a short distance from the guide 124, an actuator 129 which performs an alternating rectilinear movement with an associated speed and phase electronic control motor 130 and to the slide 131 of which the carriage 123 with the said gripper P4 is connected.

[0017] When the gripper P4 transfers the group of bottles into the station Z5, the bottles rest on a horizontal conveyor 132 which is parallel to the said gripper and supported in cantilever fashion at the end opposite to that where the said gripper enters, as indicated by 133, so as not to interfere with the latter and controlled by means which ensure that it operates in synchronism with the said gripper P4 (see below). The station Z5 is provided above the conveyor 132 and perpendicularly with respect thereto with a bridge crane 134 which travels on horizontal guides 135,135' parallel to the said conveyor 132 and fixed onto the support shoulders 24 and 24" of the machine. The bridge crane 134 is connected to a horizontal adjusting device 136 which is secured to the shoulder 24, for adjusting the position of the said bridge crane and the means mounted on them, upon variation in the size of the bottles to be sealed. The bridge crane 134 has, mounted on it, guides 137 which slidably support a carriage 138 which carries the capping head 139 which is mounted on the said carriage by means of a pair of vertical displacement actuators 140,140', of the screw/female-thread type, which are connected by means of the positive drive 141 to a speed and phase electronic control motor 142. The capping head comprises a plurality of vertical spindles 143 of the known type which are identical and provided with a respective motor and a respective gripper for gripping the cap, for example of the pneumatically actuated type, and are arranged so as to operate on the row of bottles positioned on the conveyor 132 by the gripper P4. Since there is a relatively long time available for the capping operation, the capping spindles are of a number such that they seal the group of bottles cyclically introduced into the station Z5, in several successive stages. If, for example, the bottles which cyclically reach the station Z5 are in groups of eighteen and have small dimensions, the capping spindles 143 are, for example, five in number and are separated from one another at an interval twice that of the said bottles. The carriage 138 is connected, by means of a positive drive 144, to a speed and phase electronic control motor 145. By means of the motor 145, the capping head may be displaced from the position where it is aligned with the bottles, to a position displaced to the left (as viewed in Figures 14 and 15) in alignment with a cap supplying station 146, whereas, when the motor 142 is activated, the said capping head may be lowered and raised so as to remove caps from this station 146 and then screw the said caps onto the bottles. In order to allow adaptation to bottles of varying size, the station 146 is mounted on the support shoulder 24" via a double horizontal and vertical slide and guide system 181, 182 with associated adjusting devices 183, 184. The station 146 comprises (Fig. 3) a vibrating device 147 inside which the caps are supplied in loose form and which directs and aligns in a single file the said caps and which, by means of a curved guide 148 transfers them to a horizontal rectilinear conveyor 149, with lateral retaining guides, which in turn supplies

the said caps to a horizontal curved guide 150, the outlet end of which is intercepted by servo-controlled means indicated schematically by the arrows 151. The vibrating device 147 and the conveyor 149 are supported by a support 152 which is fixed onto a slide 153 which is secured to a device 154 for adjusting the heightwise position and which slides on a vertical guide 155 which is fixed onto the support structure of the machine. The end part of the curved guide 150 is located to the side of and at the end of a straight channel which is parallel to the conveyor 132 and is formed at the bottom by a fixed wall 156 which extends beyond the said guide 150 and is formed laterally by a straight external side-wall 157 and by an opposite side-wall 158 in the form of combs with a sawtooth profile directed towards the inside of the channel in question. The number of equidistant recesses of the side-wall 158 is for example equal to the number of spindles 143 of the capping head 139, said recesses having the same interaxial distance and their shape being designed to contain a cap (see below). The two side-walls are arranged so as to pass from an active position, where they are situated as close as possible to one another, as shown in Figure 14 by broken lines, such that a cap T may be arranged between the side-walls in question, being seated in each recess of the side-wall 158, to a position where they are located at a distance from one another, in which the said side-walls are shown in continuous lines. From Figures 14, 15 and 16 it can be seen that the external side-wall 157 is slidable transversely on a pair of supports 159,159' attached to a fixed support structure 160 and the said side-wall is connected, by means of an intermediate and guided transmission system 161, to a horizontal cylinder 162 which transmits to the side-wall 157 the abovementioned translation movement. The internal side-wall 158 must perform a transverse movement in the same manner as the other side-wall and also must be able to be displaced longitudinally. For this purpose, the side-wall 158 is supported, so as to be transversely slidable, by supports 163,163' which are interconnected by a slide 164 which travels on a guide 165 with a matching profile, for example in the form of a dovetail or equivalent form, which is fixed laterally and longitudinally with respect to the support body 160. The supports 163,163' have fixed, longitudinally underneath them, a rack 166 with toothing directed downwards and co-operating with the pinion 167 of a speed and phase electronic control motor 167', which, upon operation, longitudinally displaces the comb-shaped side-wall 158. The slides, by means of which the side-wall 158 co-operates with the supports 163,163', are interconnected by a slide 168 which travels on a straight guide 169 parallel to the side-wall 158 and connected to a guide/slide group and to a horizontal rectilinear actuator 170 which is transverse to the said guide and by means of which the said side-wall 158 may be provided with the necessary transverse movement. At the start of a working cycle, the side-walls 157 and 158 are in a position at a distance from one another, as can be seen in Figure 14, and the comb-shaped side-wall 158 is displaced longitudinally so as to be arranged with the first of the recesses of its sawtooth profile, opposite means 151 for stopping the caps, following which the side-walls 157,158 return into the position where they are located as close as possible to one another and the means 151 open so as to allow a cap to enter into the first recess of the side-wall 158 which then performs a longitudinal movement so as to return into the original position facing the side-wall 157, while a cap is arranged in each recess of this side-wall 158 and then in synchronism the said means 151 close the outlet of the guide 150. Once the predefined number of caps have been positioned in the station 146, raising is performed through openings in the end wall 156 of a comb-shaped structure 171 which is actuated by a cylinder 172 and which, with its teeth and/or recesses directed upwards, co-operates with the caps T so as to centre them correctly, following which the side-walls 157 and 158 are operated so as to move away from each other, as can be seen in Figure 14, so as to release the caps laterally. In synchronism, the capping head 139, which has previously been arranged in position in the station 146, is lowered and with grippers 143' grips the caps T, following which it moves upwards and in synchronism is displaced and then moves downwards into the station Z5 in order to apply the said caps to the first odd-numbered bottles. During the next cycle, the bottles are made to advance by an interval equal to the distance existing between one bottle and the next one and the caps will be mounted on the first even-numbered bottles. During the following cycle, the bottles are made to advance so as to align with the capping head the last bottles which will be sealed with two further travel movements of the capping unit, now removing four caps each time from the station 146. In this case the comb-shaped side-wall 148 will be loaded with only four caps. By means of the electronic control motor 167' and by means of the intercepting device 151, the machine control unit will be able to achieve easily the abovementioned object.

[0018] After capping of the whole group of bottles, the gripper P4 opens and returns into the filling station Z4 in order to grip new bottles to be sealed, while the already sealed bottles are conveyed away by the conveyor 132 and by a following acceleration conveyor 132'. The capping station Z5 may be provided with known means for marking and/or for otherwise ensuring the discarding by other suitable means, not shown, of those bottles, capping of which proved due to be inadequate during known torque tests or tests of another type carried out in the said station Z5.

[0019] From Figure 1 it can be seen that the machine is provided in the internal corner, between the extruder and the bottle processing line, with a jib crane 173 which pivots on a vertical fulcrum 174 and the arm of which has an extension such that it is able to serve the

entire extruder and all the stations from Z1 to Z3. The stations Z4 and Z5 are served instead by a small jib crane 175, with arm and forearm which are hingeably joined together on a vertical axis and pivotably mounted at 176 on the machine frame. By means of these cranes, it will be possible to perform easily the operations involving maintenance and setting-up of the machine for the production, filling and sealing of bottles of different sizes. The electric wiring consoles 177 are, for example, located on the rear side of the bottle processing line and comprise a programmable electronic control unit 178 which governs automatic operation of the entire machine. The front side of the machine is provided with a longitudinal gangway 179 on which one or two operators may stand, said operators having access to operating and control consoles 180,180', with all the emergency controls as required. The whole machine is provided with a protective housing, not shown, with partly transparent hatches, inside which a controlled atmosphere, useful for the packaging of products which require this condition, may be created if necessary.

[0020] It is understood that the description refers to a preferred embodiment of the invention, to which numerous variations and modifications, in particular of a constructional nature, may be made, said variations or modifications for example relating to the use of a filling station different from that described and capable, for example, of performing volumetrically controlled filling, all of which without departing from the underlying principle of the invention, as described above and as illustrated and claimed below. In the claims, the reference numbers shown in brackets are purely exemplary and do not limit the protective scope of the said claims.

Claims

1. Automatic machine for manufacturing, checking, filling and capping bottles made of thermoplastic material, characterized in that it comprises:

   - at least one group (1,1") for extruding thermoplastic material, so as to produce several parisons (P) arranged alongside each other;
   - a mould and counter-mould group (S,S') with several adjacent cavities, mounted on self-centring horizontal-movement slides (13,13') located on a translating carriage (19) which by suitable means is transferred alternately from a position where the said cavities are centred with respect to the extruded parisons, onto which they are then closed so as to grip a section thereof of predetermined length, to a work station (Z1) which performs blowing of the gripped parison sections, for formation of the bottles, while means are provided for ensuring that, during the alternating translatory movement of the said carriage, the extrusion group remains active for manufacture of the parisons for the following cycle;
   - if necessary, means for introducing into the mould and into the counter-mould (S,S'), when open in the parison extrusion station, labels treated with thermal adhesives, which will then adhere to the formed bottles;
   - stations (Z2-Z5) for processing the bottles, which are aligned with one another and with respect to the said blowing station (Z1) and which are responsible for performing, respectively: sprue-removal and calibration of the mouth (Z2); checking of the compression and sealing strength (Z3); filling (Z4) and capping (Z5) of the said bottles;
   - gripper groups (P1-P4) with a self-centring closing and opening movement, which in synchronism grip the groups of bottles cyclically produced in the blowing station and transfer them into the following work stations and then to the outlet point;
   - underneath the line formed by the successive stations for processing of the bottles (Z1-Z5), a conveyor (59) which collects and removes all the production waste produced in these stations, such as the sprue and the defective bottles which do not remain suspended from the blowing nozzles or the mouth-calibrating punches or which are selectively discarded in the said stations if defective;
   - an electronic unit (178) which dialogues with the various working units of the machine and which ensures automatic operation of the machine itself.

2. Machine according to Claim 1, in which the carriage (19) which carries the mould and counter-mould group (S,S') is movable on horizontal guides (21-23) aligned with the line of the stations (Z1-Z5) for processing the groups of bottles which are cyclically produced, and the opening and closing movement of the said mould and counter-mould group is perpendicular to the said guides such that the groups of bottles produced are aligned relative to the said working line, with respect to which the extrusion group (1,1") is oriented perpendicularly, so that opposite the said working line, on the other side of the mould and counter-mould group, any means (L) for automatically supplying thermoadhesive labels may be arranged.

3. Machine according to claim 1, in which the extrusion group (1,1") is mounted on a platform which is pivotably mounted in between and transversely (6) on a sturdy support structure (7) and means (8-10) are provided for imparting a correct pitching movement to the said extrusion group, so as to raise the extrusion head (4) during the movement of the

mould and counter-mould group (S,S') away from the latter and so as to lower it during the reverse operation, so that the said extrusion group is able to operate continuously.

4. Machine according to the claim 2, in which the hydraulic control unit (12) which supplies the various servo-controlled devices of the machine itself is mounted underneath the structure (7) which supports the extrusion group with the possibility of performing a pitching movement.

5. Machine according to the claim 1, in which the carriage (19) with the mould and counter-mould group (S,S') is mounted in cantilever fashion with the part directed towards the extrusion group, on a pair of straight and horizontal guides (21, 22), and, with the more projecting part, rests and slides on a third guide (23), all of which so as to ensure easy accessibility to the said carriage for the maintenance operations and for changing the mould and counter-mould group when there is a variation in the size of the bottles.

6. Machine according to the claim 5, in which, by way of continuation of the guides (21,22) on which the carriage (19) with the mould and counter-mould slides, further horizontal guides (39) are provided, said guides having, sliding on them, a carriage (40) which supports in cantilever fashion and therefore with very ease access for the maintenance and replacement operations a first set of three grippers (P1-P3) with a self-centring closing and opening movement, which are located in succession to one another and which are responsible for transferring groups of bottles between the blowing station (Z1), the sprue-removal and mouth-calibrating station (Z2), the quality control station (Z3) and the filling station (Z4), it being envisaged that this carriage with the grippers derives the alternating movement from the same means which actuate the said carriage (19) with the mould and counter-mould group, so that the two carriages move at the same time, in the same direction and at the same speed.

7. Machine according to Claim 6, in which the means which actuate the carriage (19) with the mould and counter-mould group, and the carriage (40) with the first three grippers (P1-P3) for transfer of the groups of bottles between the first four work stations (Z1-Z4), consist of a horizontal fluid-pressure and double-acting cylinder (26) which is fixed with its body to the base shoulder (24) of the machine and the rod of which projects from both ends of said body and is connected to the said carriages.

8. Machine according to Claim 6, in which the carriage (40) which carries the first three groups of grippers (P1-P3) is provided in cantilever fashion with a horizontal frame (41) which has, transversely fixed onto it, guides (42,42'; 71,71') on which pairs of slides (43,43'; 72,72') parallel to each other and with respect to the longitudinal axis of the machine slide and these guides are actuated with a self-centring movement by means of respective pairs of double-acting and fluid-pressure cylinders (46,46'; 74,74') and respective levers which are pivotably mounted in between and synchronization tie-rods (48,47,47',76; 75,75'), the comb-shaped jaws (45,45'; 73,73') of the first two grippers (P1,P2) responsible for transferring the groups of bottles between the first three work stations (Z1-Z3) of the machine being mounted on the said slides, and it being envisaged that horizontal beams (103,103') are fixed to the slides of the second gripper and carry the jaws (104,104') of the third gripper (P3) responsible for transferring a group of bottles from the checking station (Z3) to the filling station (Z4).

9. Machine according to Claim 8, in which the sprue-removal devices (50,50'; 51;51') which operate on the bottom of the bottles are mounted on the slides (43,43') which carry the jaws of the first gripper (P1) for transferring the bottles from the blowing station (Z1) to the calibrating/sprue-removal station (Z2), whereas the sprue-removal devices (52-54) which operate on the top of the said bottles are located in the said second work station (Z2) and are supported with the possibility of adjustment (57) by the rear shoulder of the machine base.

10. Machine according to Claim 8, characterized in that the second gripper (P2) which transfers the bottles from the second to the third work station has the jaw (73) which is directed towards the rear support shoulder (24) of the machine, directly fixed onto the associated slide (72), whereas the other jaw (73') is mounted on the associated slide (72') by means of vertical guide/slide groups (79,79') and a vertical displacement actuator (80) and this vertically movable member has, integral with it, the beam (103') which carries the external jaw (104') of the third gripper (P3) such that this jaw which is normally in a high position facing the other jaw (104) in order to grip the bottles is able, upon operation, to be lowered so as to allow the selective discarding of the bottles located in the third work station (Z3) if the latter do not pass the quality control test, it being envisaged that the discarded bottles are conveyed by means of chutes (102) onto the waste collection and removal conveyor (59) which travels longitudinally along the machine in question.

11. Machine according to the claim 10, characterized in that opto-electronic sensors (200,200') are mounted on the internal and vertically non-movable

jaw (73) of the second gripper (P2) in a quantity and with a position such as to detect any presence of residual sprue at the top and bottom of the bottles which the gripper in question is about to remove from the second sprue-removal and calibrating station (Z2), it being envisaged that the said sensors are connected to an electronic apparatus which is able to determine the position of the defective bottles and subsequently effect discharging thereof by the extractors associated with the calibrating station, before the jaws of the said gripper (P2) close in order to grip the said bottles.

12. Machine according to the claim 8, characterized in that a set of nozzles (101,101') which can be selectively connected to a source delivering compressed air and are directed perpendicularly relative to each bottle is mounted on the internal vertically non-movable jaw (104) of the third gripper (P3) responsible for transferring the bottles from the quality control station (Z3) to the filling station (Z4), in order to eliminate the defective bottles from the said third station, after lowering of the external jaw (104') of the said third gripper (P3).

13. Machine according to the claim 1, in which the blowing station (Z1) is provided with a head (31) having a plurality of vertical nozzles (32), with a known form, which are directed downwards and are aligned and connected to a header (33) for delivery of the compressed blowing air, the said head being mounted slidably and in cantilever fashion on a vertical guide (30,30') which is in turn mounted on a slide (29) which by means of an adjusting device (28) may be made to slide on a support plate (24') fixed to the rear shoulder of the machine, the said vertical guide (30,30') having, mounted on it, the assembly (35,36) which allows adjustment of the heightwise position of the head (31) and which, upon operation, moves it vertically so as to insert and extract the nozzles into and from the cavities of the mould and counter-mould group (S,S') above which the said head in question has a fixed extraction comb (37) through which the said blowing nozzles pass and which is useful for the extraction of the same nozzles from the bottles extracted from the mould and counter-mould group and gripped by the transfer grippers (P1).

14. Machine according to the claim 1, in which the second work station (Z2) responsible for calibration and sprue-removal is provided with a first slide (62) which travels in cantilever fashion on a vertical guide (63) fixed onto a further slide (64) travelling on a vertical guide (66) with height adjusting means (65) and this latter guide being mounted horizontally slidable, with an appropriate adjusting device (201), on a support plate (24') integral with the rear shoulder (24) of the machine, and said first slide (62) having, mounted on it, a horizontal header (61) from which there extend, directed downwards, vertical punches (60) which are connected to the said header for circulation therein of a cooling liquid and these punches having a shape suitable for entry into the mouth of the bottles so as to cool it and perform calibration thereof and being surrounded by a respective extractor (70) which normally is kept raised by an associated fluid-pressure cylinder (69) fixed with its body onto the said header, and the slide which carries the calibrating punches is connected to the rod of at least one raising and lowering actuator (68), for example a fluid-pressure cylinder fixed with its body onto an arm (67) in turn fixed in cantilever fashion onto the said second vertical slide (64).

15. Machine according to the claim 1, in which means are provided for ensuring that the extractors (70) associated with the punches (60) for calibration of the bottle mouths are activated selectively prior to closing of the second gripper (P2) for transfer of the bottles from the second sprue-removal/calibrating station to the following checking station, in the event that the said opto-electronic sensors (200,200') associated with this second gripper detect the presence of residual sprue on the said bottles, and means are provided for ensuring that, after closing of the said gripper (P2), all the extractors are activated in synchronism with raising of the calibrating punches, so as to facilitate extraction of the said punches from the calibrated bottles.

16. Machine according to the claim 1, characterized in that the third station (Z3) responsible for quality control of the bottles comprises a horizontal bench (81) which is supported in cantilever fashion by the rear support shoulder (24) of the machine, via a vertical slide/guide group (83) and adjusting means (84) which allow adaptation of the heightwise position of the said bench on which the group of bottles rest when released by the second transfer gripper (P2) and it being envisaged that each bottle is retained on the said bench by the vacuum created via special holes (85) and via a respective circuit (86,87) by associated suction means, and means are envisaged for selectively interrupting suction in these circuits when the nozzles (101) associated with the internal jaw (104) of the third gripper (P3) are selectively activated, in order to eliminate the bottles found to be defective during quality control.

17. Machine according to the claim 16, in which the bench (81) supporting the bottles in the third work station (Z3) is supported in cantilever fashion with respect to the internal jaw (73) of the second gripper (P2) for gripping and transferring the bottles,

such that the uprights (78) supporting this jaw do not interfere with the support (82) of the said bench when the said second gripper is positioned in the said third station (Z3).

18. Machine according to the claim 1, in which the third work station (Z3) responsible for quality control of the bottles comprises a parallel horizontal bar (88) which is located above the said bench (81) supporting the bottles to be tested and which is supported by a slide (89) which is mounted in cantilever fashion and with the possibility of heightwise adjustment of the position by means of a special adjusting device (91) on a vertical guide (90) fixed onto the rear shoulder (24') of the base of the machine, the said bar having, fixed onto it, by their bodies, double-acting fluid-pressure cylinders (92) which are of a number and have a relative position equal to the group of bottles to be tested and are vertical and directed downwards with the associated rod on which there is mounted a bell member (93) from which a probe (95) pushed downwards by resilient means projects at the bottom and in an axial position and which normally closes at one end a circuit (94) open with the other end on the base of the said bell member or on the bottom end of the said probe and which, with the middle part, is connected to a source delivering air under pressure (98) and to means (99) which emit an electric signal proportional to the pressure created by the said source and which in turn are connected to an electronic control unit, it being envisaged that the rods of the said cylinders are normally in a raised position such that the bottles to be checked may be positioned underneath them and means being provided to ensure that, once the bottles have been positioned on the said bench (81), the said cylinders are actuated so as to extend and insert the associated probe (95) into the mouth of the associated bottle and so as to sealingly close the mouth of the said bottle with the said bell member and means being provided in order to introduce air into each bottle and verify by means of the said control means (99) whether the pressure remains in the bottles at a predetermined value within a predefined period of time and if this condition is detected, the bottles are considered to be suitable for filling, whereas, in the opposite case, for example owing to the presence of holes or microscopic apertures or owing to the presence of occlusions in the mouth, which have produced raising of the said probe and consequent discharging of the inflating circuit, the bottles found to be unsuitable are discarded.

19. Machine according to Claim 18, characterized in that the fluid-pressure cylinders (92) of the checking units of the third work station (Z3) have an extension stroke and are supplied during extension with a pressure such as to subject the tested bottles to a predefined degree of compression, and suitable sensors (100,100'), for example of the magnetic type, are provided in order to detect the stroke of the piston of the said cylinders (92), these sensors being connected to an electronic control unit which regards as suitable for filling, the bottle where the sensor sensing the end of the extension stroke of the cylinder (92) remains switched for the duration of the test, whereas, if this sensor is not switched or is switched and then switched back again, the tested bottle is discarded.

20. Machine according to the claim 1, in which the fourth work station (Z4) responsible for filling the bottles with a predetermined quantity of liquid product comprises a horizontal bench (105) which is supported in cantilever fashion by a vertical slide/guide group (109,110) with associated adjusting device (112) for adjusting, when there is a variation in the size of the bottles, the heightwise position of the said bench on which a plurality of weighing scales (106) are mounted, being of a number and having an arrangement such that a bottle to be filled transferred by the said third cantilever gripper (P3) is arranged on the pan (107) of each of them, a respective nozzle (119) delivering the liquid product to be packaged being positioned above each bottle and this nozzle being controlled by a respective solenoid valve (120) preferably of the proportional or equivalent type and being connected to a liquid supply tank (117), which is mounted in cantilever fashion on the support shoulder (24) of the machine, via a double vertical (115) and horizontal (113) slide/guide group, with associated adjusting devices (114, 116), so as to allow the perfect centring of the said distribution nozzles (119) on the bottles.

21. Machine according to Claim 20, in which means are provided for ensuring that, once the bottles have been transferred into the filling station (Z4), the scales (106) detect whether or not the bottles are present and, in the case where they are present, detect the tare of the bottles themselves and cause opening of the associated nozzles (119) supplying the product, following a procedure which ensures correct filling of the said bottles, without the formation of foam and so that the said procedure is automatically adjusted in accordance with the weight of the bottles read at the end of filling.

22. Machine according to the claim 1, in which transfer of the bottles from the fourth filling station (Z4) to the last capping and removal station (Z5) is performed by a fourth gripper (P4), the comb-shaped jaws (121,121') of which are mounted with self-centring opening and closing means on a carriage

(123,131) slidable on straight guides (124-129) parallel to the longitudinal axis of the machine and fixed in cantilever fashion on a vertical guide/slide group (126,127) mounted on the rear shoulder (24) of the base of the machine itself and provided with an adjusting device (128) with which it is possible to adjust the heightwise position of the said gripper when there is a variation in the size of the bottles, the said carriage being actuated by a movement unit (130) of the type with electronic control of the speed and phase, which is governed by the control unit of the machine.

23. Machine according to the claim 22, in which the jaws of the fourth gripper (P4) are supported by the associated slide (123) with a cantilever arrangement with respect to the fourth work station (Z4) and the bench (105) with the scales of this station is supported in cantilever fashion with respect to the fifth work station (Z5) so that the said gripper is able to be inserted into the said fourth station for gripping of the filled bottles, without interference between the parts supporting the said gripper and the said bench (105).

24. Machine according to the claim 1, in which in the fifth work station (Z5) the bottles rest on a rectilinear and cantilevered conveyor (132) actuated by special means in synchronism with the fourth gripper (P4) and in this station there being provided a capping head (139) with several independent spindles (143) for gripping and screwing the caps, which are located vertically and with an arrangement and of a number such as to be able to engage with the bottles transferred into this latter station, the said spindles (143) being mounted via vertical raising and lowering means (140,140'; 141,142) on a carriage (138) which slides on the straight guides (137) fixed onto the lintel of a bridge crane (134) positioned transversely on the shoulders (24,24") of the base of the machine, movable on horizontal guides (135,135') fixed longitudinally on the said structure and connected to a horizontal adjusting device (136) which allows correct centring of the said spindles (143) with respect to the bottles, a station (146) being provided laterally with respect to the said conveyor (132) and parallel to the latter, for cyclically supplying a row of caps (T) which are of a number and have an arrangement such that the said caps may be picked up by the spindles of the capping head and then screwed onto the bottles.

25. Machine according to Claim 24, in which the number of spindles (143) of the capping head is a submultiple of the number of bottles which are cyclically transferred into this station and means are provided for ensuring that the capping of these bottles is performed in several successive stages involving gripping and application of the caps by the capping head (139) and with gradual feeding of the bottles by the said gripper (P4) which at the end of the cycle opens so as to allow unloading of the sealed bottles by special conveying means (132,132') on which the said bottles rest.

26. Machine according to the claim 1, in which the station (146) supplying the caps comprises a vibration device (147) which arranges the caps in a single file and uniformly directed and which, by means of a guide (148), transfers the line of said caps, directed with the cavity downwards, to a rectilinear conveyor (149) which supplies the caps themselves to a curved and horizontal guide (150), the outlet of which is intercepted by means (151) for stopping the caps and is located at the end of a horizontal channel (146) parallel to the row of bottles to be sealed and defined at the bottom by a guide (156) and laterally by parallel side-walls (157,158) connected to opening and closing means and one of these side-walls (157) is straight, while the other side-wall (158) has a comb-shaped configuration with sawteeth directed towards the other side-wall and being of a number and with an arrangement such as to contain within the associated recesses respective caps which are of a number and with an arrangement necessary for gripping by the screwing spindles (143), this side-wall being connected to longitudinal moving means (164-167) and means being provided for ensuring that, at the start of each operating cycle, the said comb-shaped side-wall is retracted and brought with the first of its recesses in the initial part of the channel formed by it, opposite the said curved guide (150), the intercepting means (151) of which open so as to release the flow of caps, while the said comb-shaped side-wall is gradually brought back into the original position facing the other side-wall, such that the caps are engaged in the recesses of this comb-shaped side-wall, it being envisaged that the end wall of the channel in question is provided with openings through which a vertical comb (171) is able to emerge in synchronism so as to centre the caps and arrange them correctly for gripping by the operating heads (143), while the said side-walls in synchronism are moved away from each other so as to allow gripping of the caps, following which the said centring device returns to its lowered position, the side-walls move back close to each other and the cycle is repeated.

27. Machine according to Claim 26, in which the longitudinal movement of the comb-shaped side-wall (158) is ensured by rack-and-pinion means (166,167) and by a speed and phase electronic control motor (167') and means are provided for controlling opening and closing of the means (151) for intercepting the curved guide (150) supplying

the caps, so that a variable quantity and arrangement of caps may be arranged in the recesses of the said comb-shaped side-wall, so as to avoid supplying of the cap to the spindle or spindles (143') of the capping head, underneath which there is no bottle to be sealed.

28. Machine according to the claim 1, in which the station (146) supplying the caps is provided with vertical (153,154,182) and horizontal (181) guide and slide groups with associated adjusting devices (154,183,184) for allowing adaptation to the caps and to the bottles of different size.

29. Machine according to the claim 1, in which the last capping station (Z5) is provided with means for checking that screwing of the caps has been correctly performed and, if necessary, for signalling and/or effecting discarding of the bottles, the cap of which has not been correctly screwed on.

30. Machine according to the claim 1, characterized in that it is provided, in the corner zone between the extruder (1,1") and the bottle processing line, with a crane (173) for example of the jib type, useful for facilitating the operations of maintenance and changing the size of the said extruder with the associated mould-carrying carriage (19) and the first three work stations (Z1-Z3), and a second crane (175) for example of the jib and articulated type is provided between the fourth and the fifth work station (Z4,Z5) in order to facilitate maintenance and the size-changing operations in these stations.

31. Machine according to the claim 1, characterized by the fact of being completely enclosed in a housing with partly transparent panelling, for protective purposes and for creating, if necessary, in the said machine an atmosphere which is controlled and, if necessary, suitable for the packaging of certain products, the front side of the machine being provided with a longitudinal gangway (179) for the operators, there being provided alongside, for example between the first and the second work station and between the fourth and the fifth work station, consoles (180,180') for the remote management of the machine and with various safety controls.

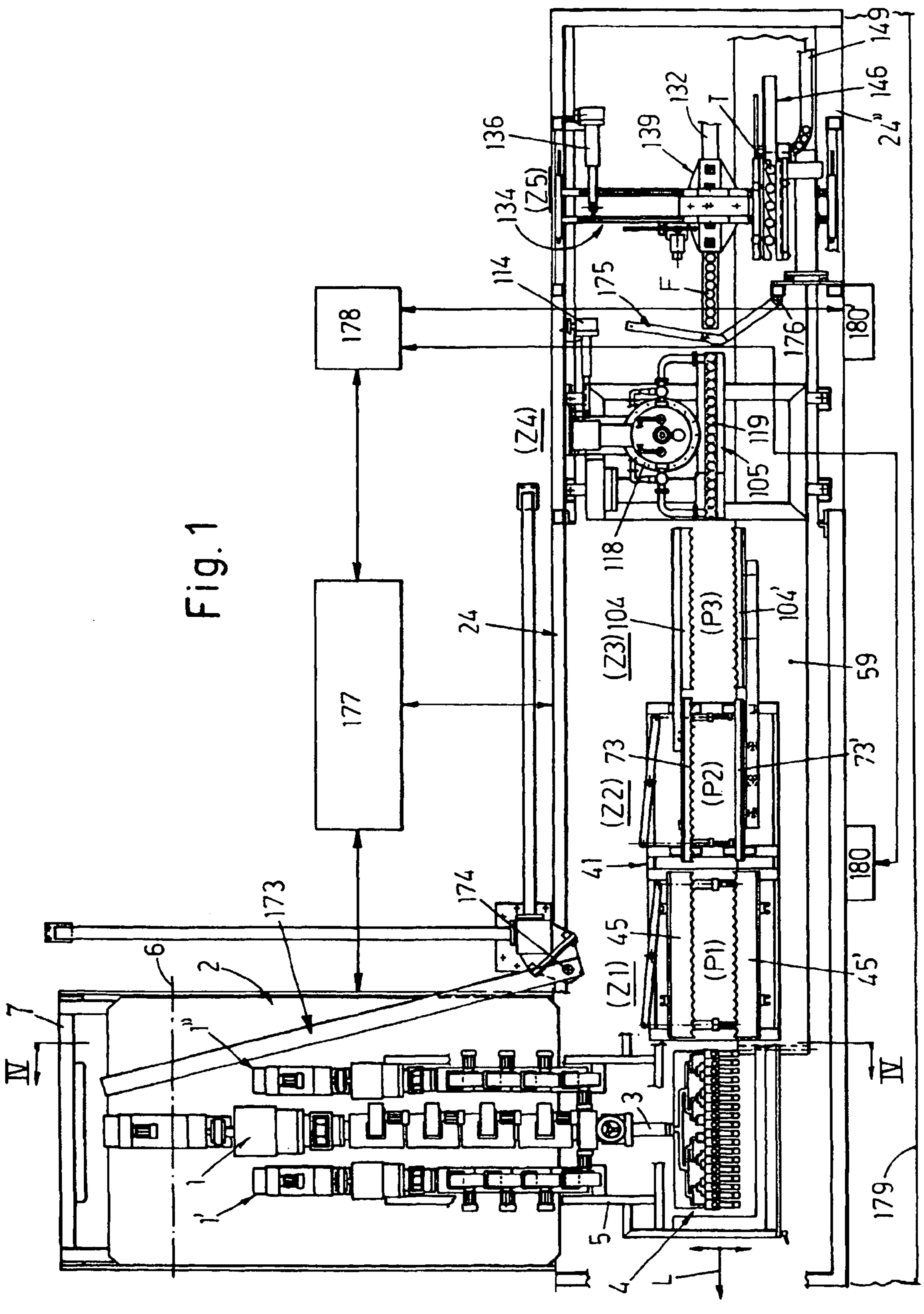
177
178
180
180'
179
24
24"
59
104
104'
105
114
118
119
132
134
136
139
146
149
173
174
175
176
41
45
45'
73
73'
(Z1)
(Z2)
(Z3)
(Z4)
(Z5)
(P1)
(P2)
(P3)
F
T
IV
1
1'
1"
2
3
4
5
6
7
L

Fig. 1

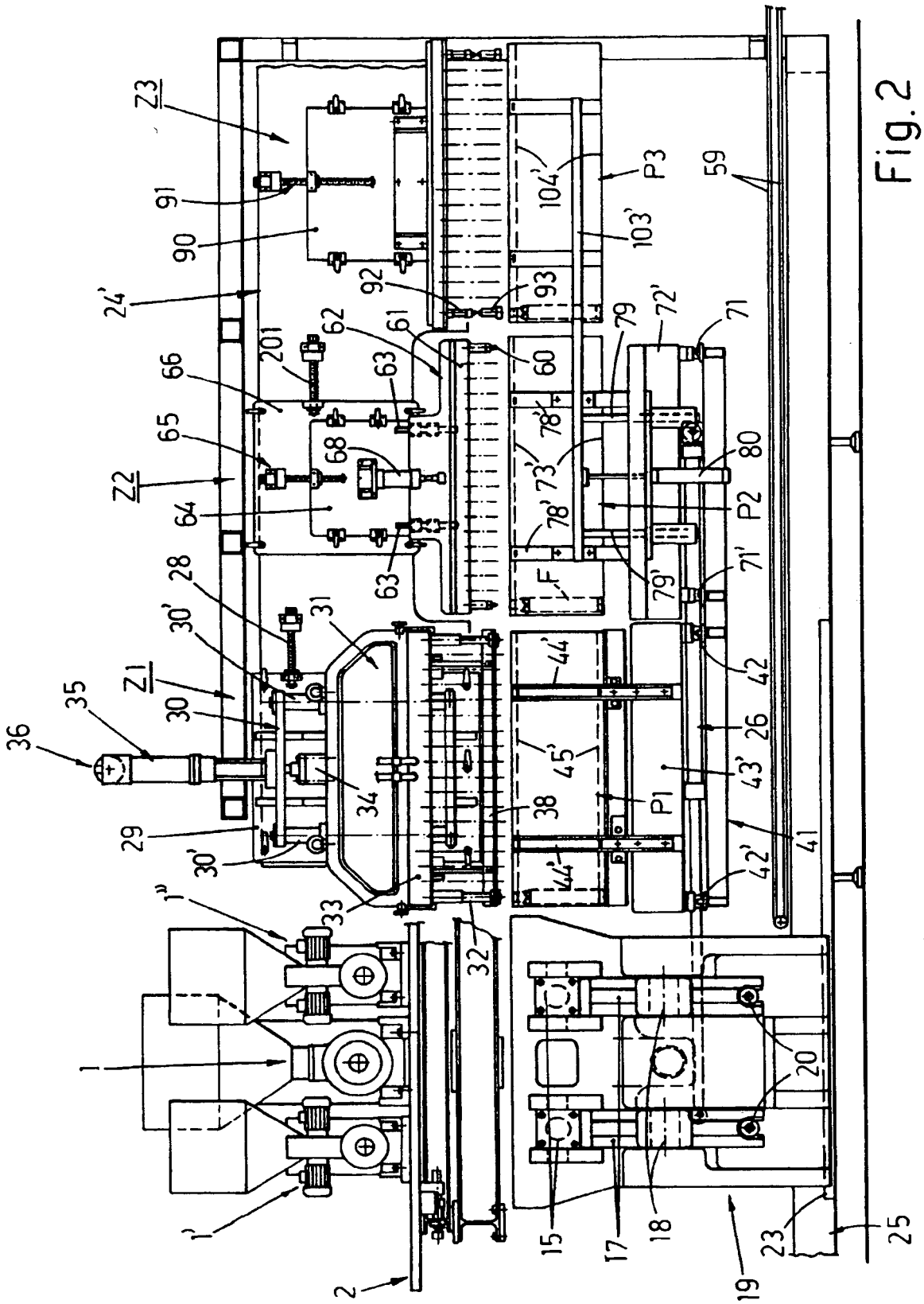
Z3
91
90
24'
92
93
104'
P3
59
103'
72'
71
79
62
61
60
201
66
63
78'
73'
80
65
68
Z2
64
78'
P2
71'
79'
F
28
30'
31
44'
42
Z1
35
30
26
36
45'
43'
34
38
P1
29
41
30'
42'
44'
33
1"
32
1
1'
2
15
17
18
20
19
23
25

Fig.2

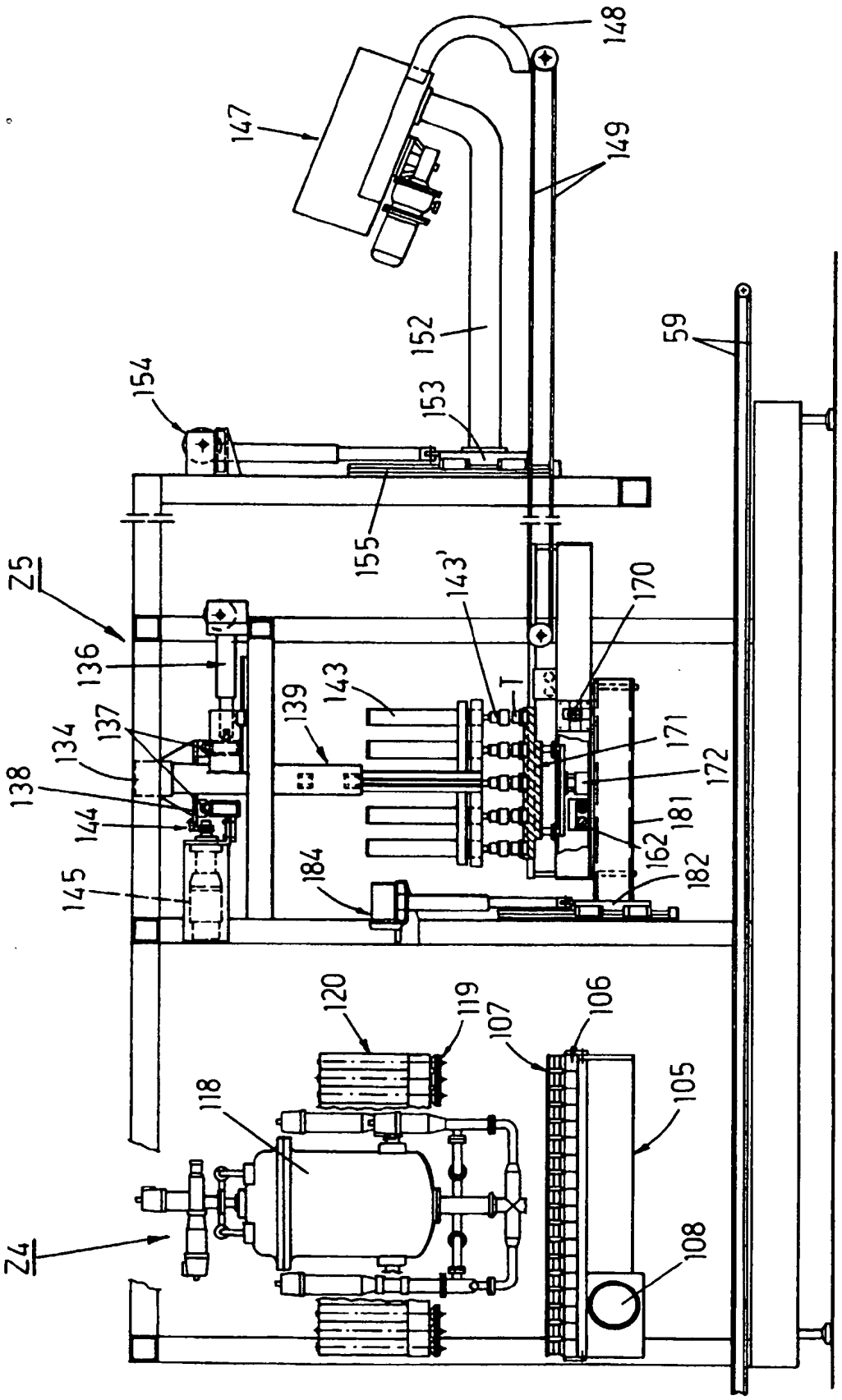
148
147
149
152
59
154
153
155
Z5
143'
170
136
143
139
T
171
137
134
172
138
144
181
162
145
182
184
120
119
107
106
118
105
Z4
108

Fig. 3

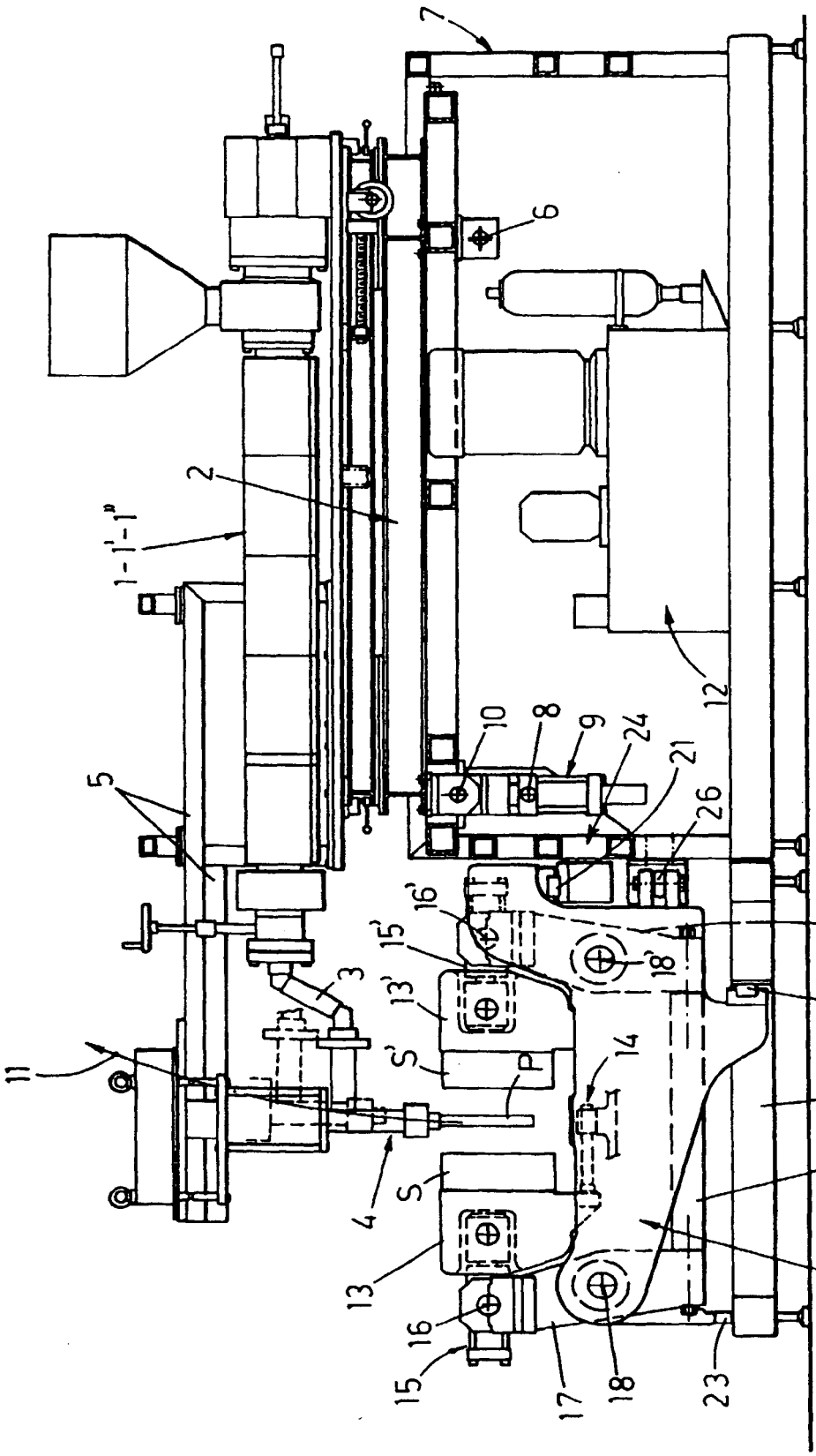
7
6
2
1-1'-1"
12
10
8
9
24
21
26
5
16'
17'
15'
18'
22
3
13'
S'
P
14
25
11
4
S
20
13
19
16
15
17
18
23

Fig. 4

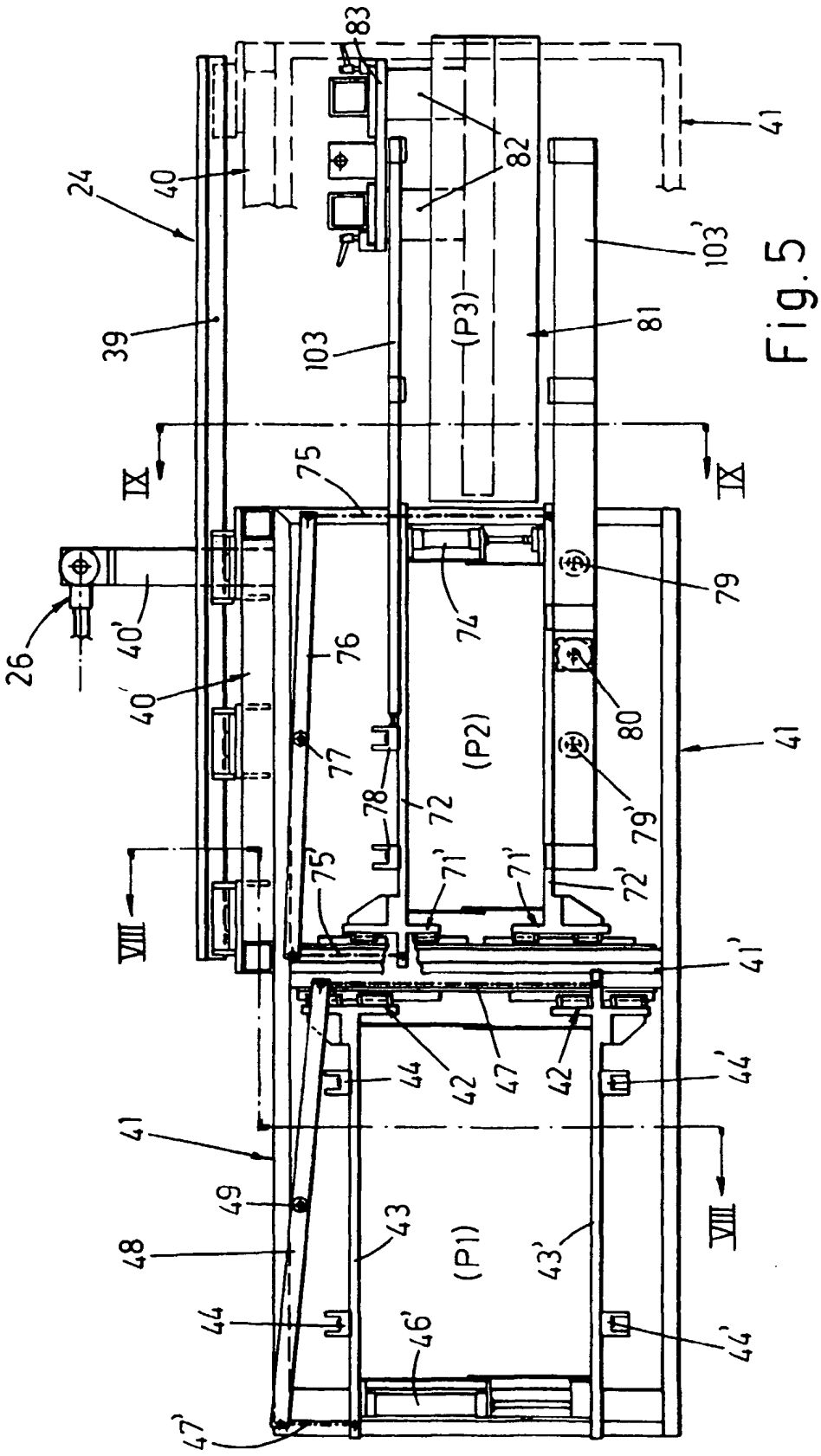
83
82
41
24
40
103'
39
103
(P3)
81
IX
IX
75
79
26
40'
74
76
40'
80
41
77
(P2)
78
72
79'
75'
71'
71'
72'
VIII
41'
44
42
47
42
44'
41
49
43
(P1)
43'
VIII
48
44
46'
44'
47'

Fig.5

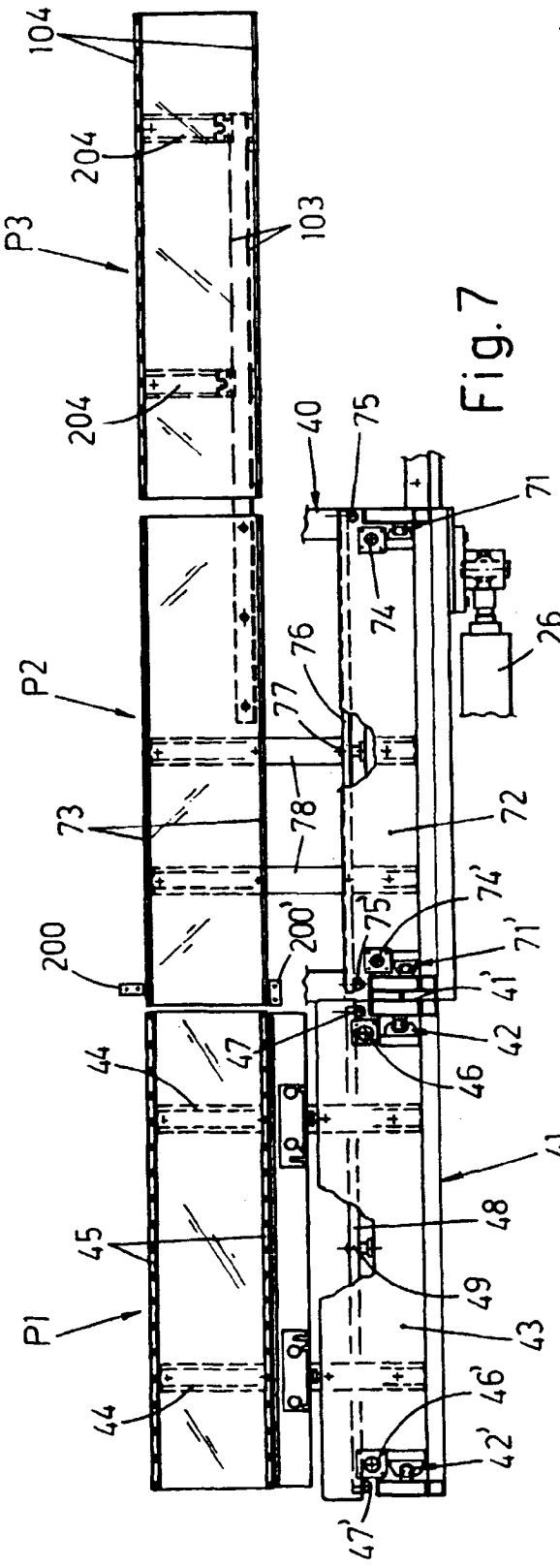
104
204
P3
103
204
40
75
71
74
26
76
77
P2
78
72
73
74'
75'
200'
71'
200
41'
42
47
46
44
41
48
45
49
P1
43
46'
42'
44
47'

Fig. 7

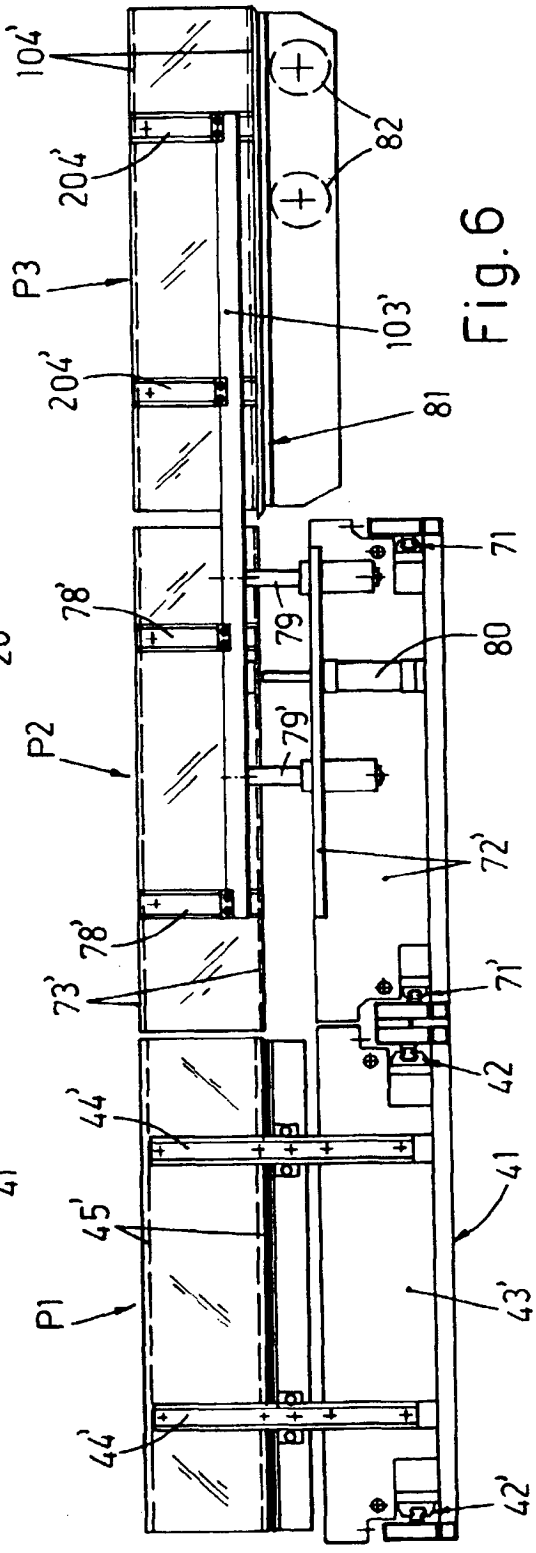
104'
204'
82
P3
103'
204'
81
71
78'
79
80
P2
79'
72'
78'
73'
71'
42
44'
41
45'
43'
P1
44'
42'

Fig. 6

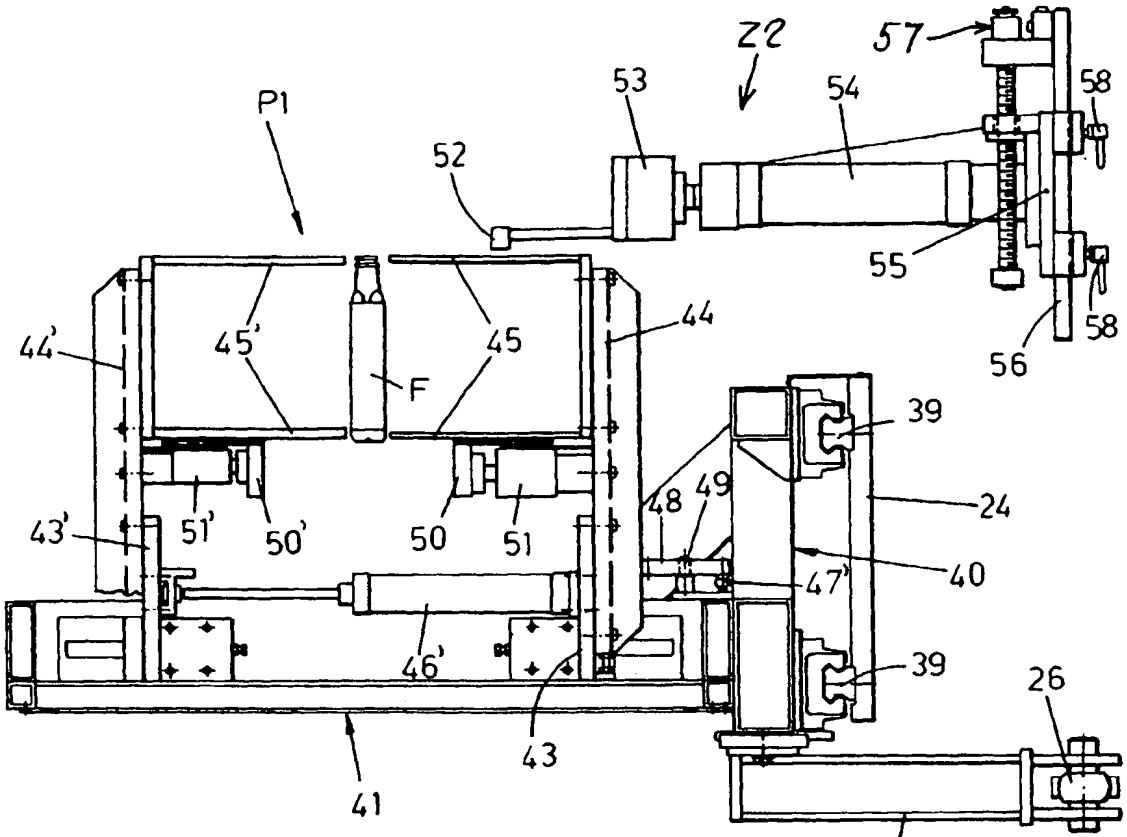
22
57
53
54
58
P1
52
55
58
56
44'
45'
45
F
44
39
48
49
24
43'
51'
50'
50
51
47'
40
46'
39
26
43
41
40'

Fig.8

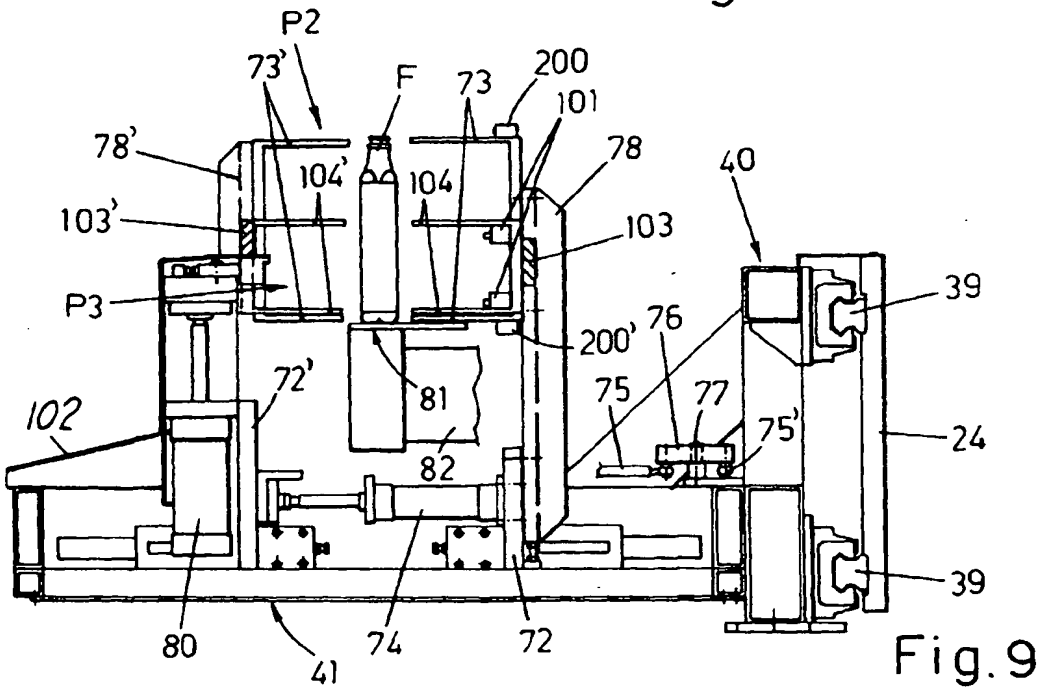
P2
73'
F
73
200
101
78'
104'
104
78
40
103'
103
P3
39
200'
76
72'
81
75
77
75'
102
24
82
80
41
74
72
39

Fig.9

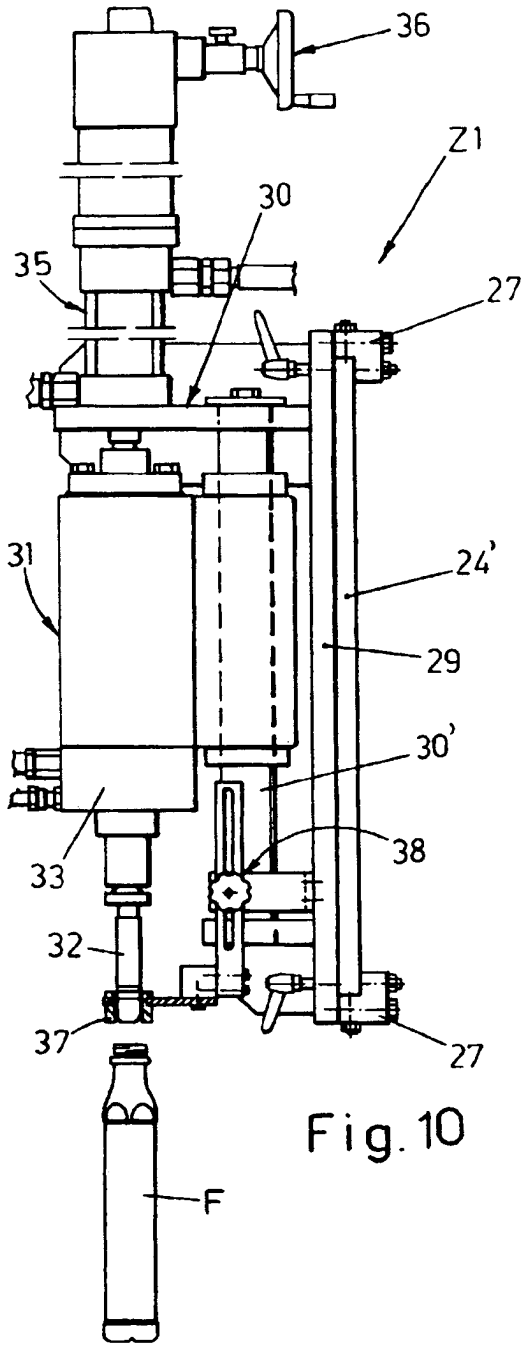
36
Z1
30
35
27
31
24'
29
30'
38
33
32
37
27
F

Fig. 10

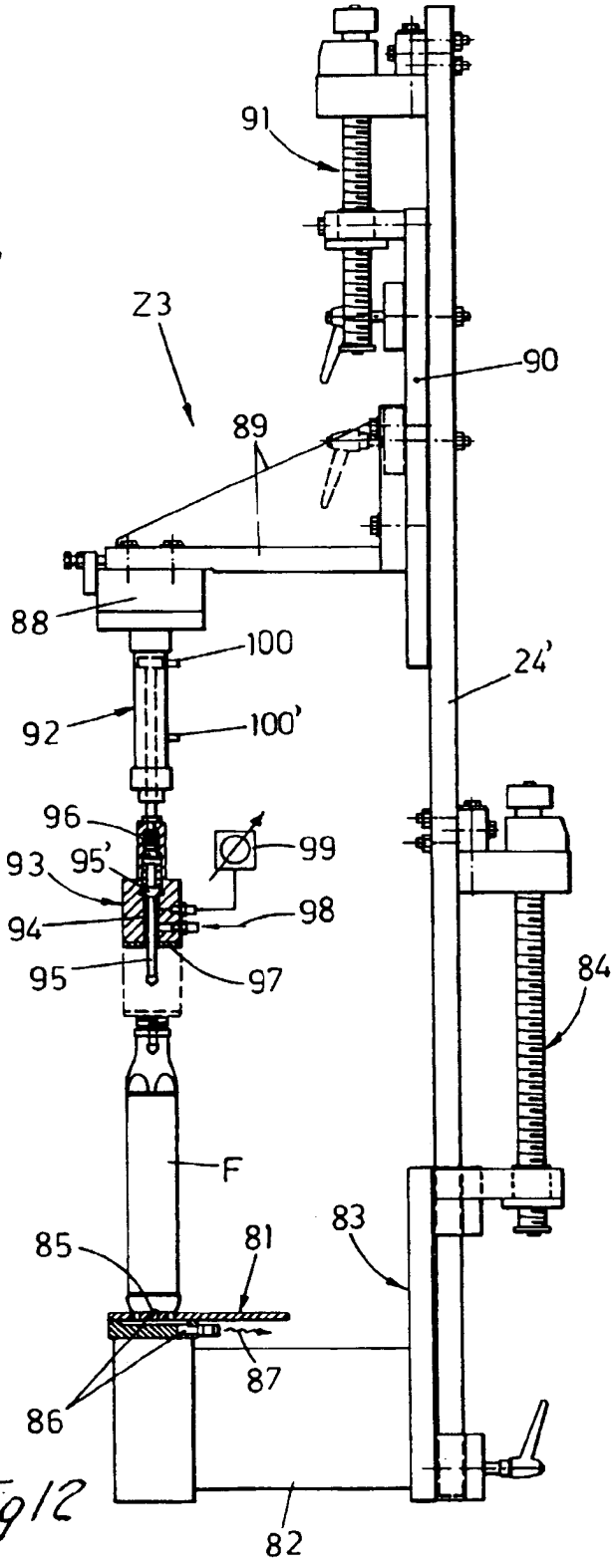
91
Z3
90
89
88
100
24'
92
100'
96
99
93
95'
94
98
95
97
84
F
83
85
81
87
86
82

Fig 12

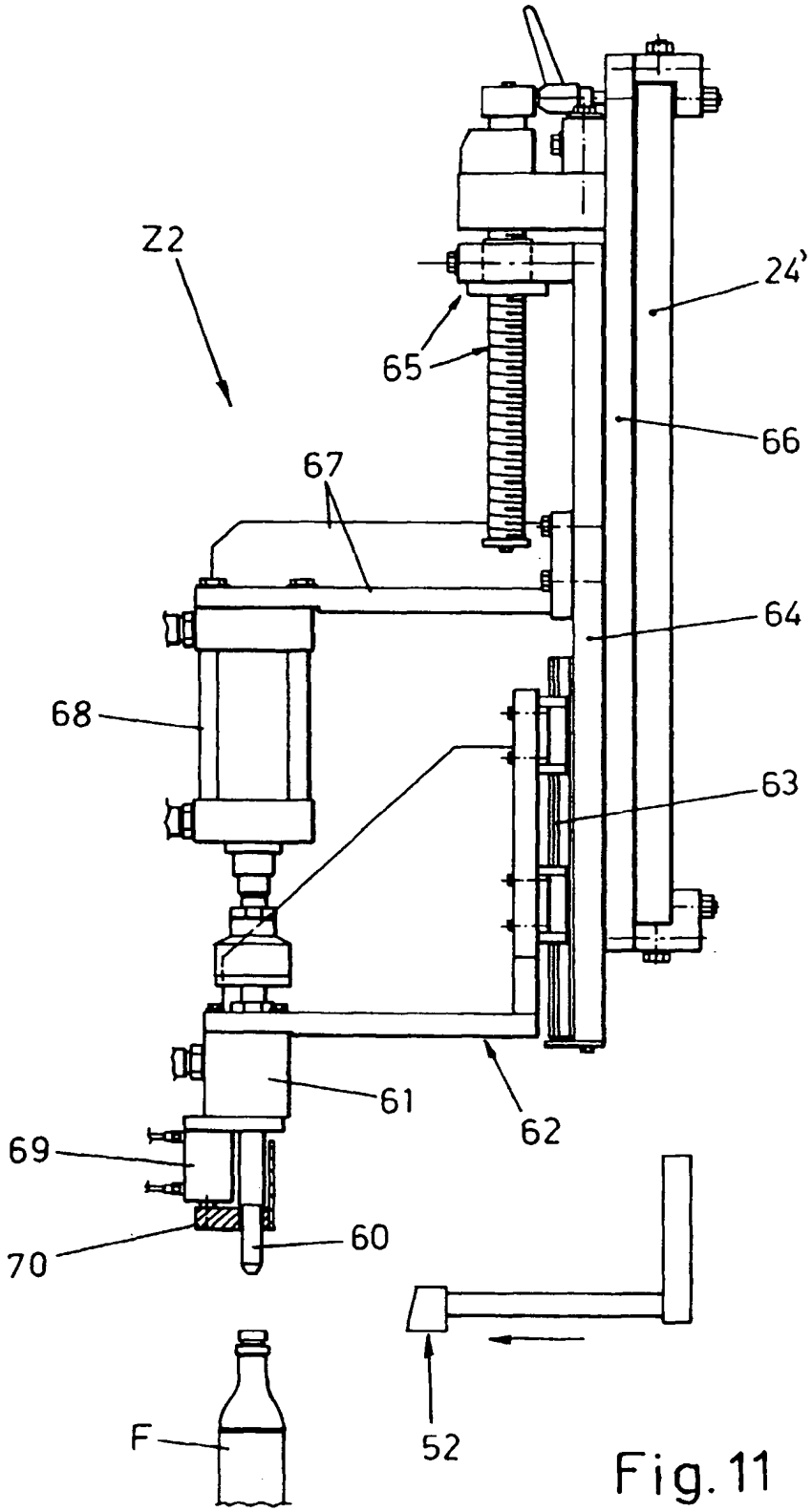

Fig. 11

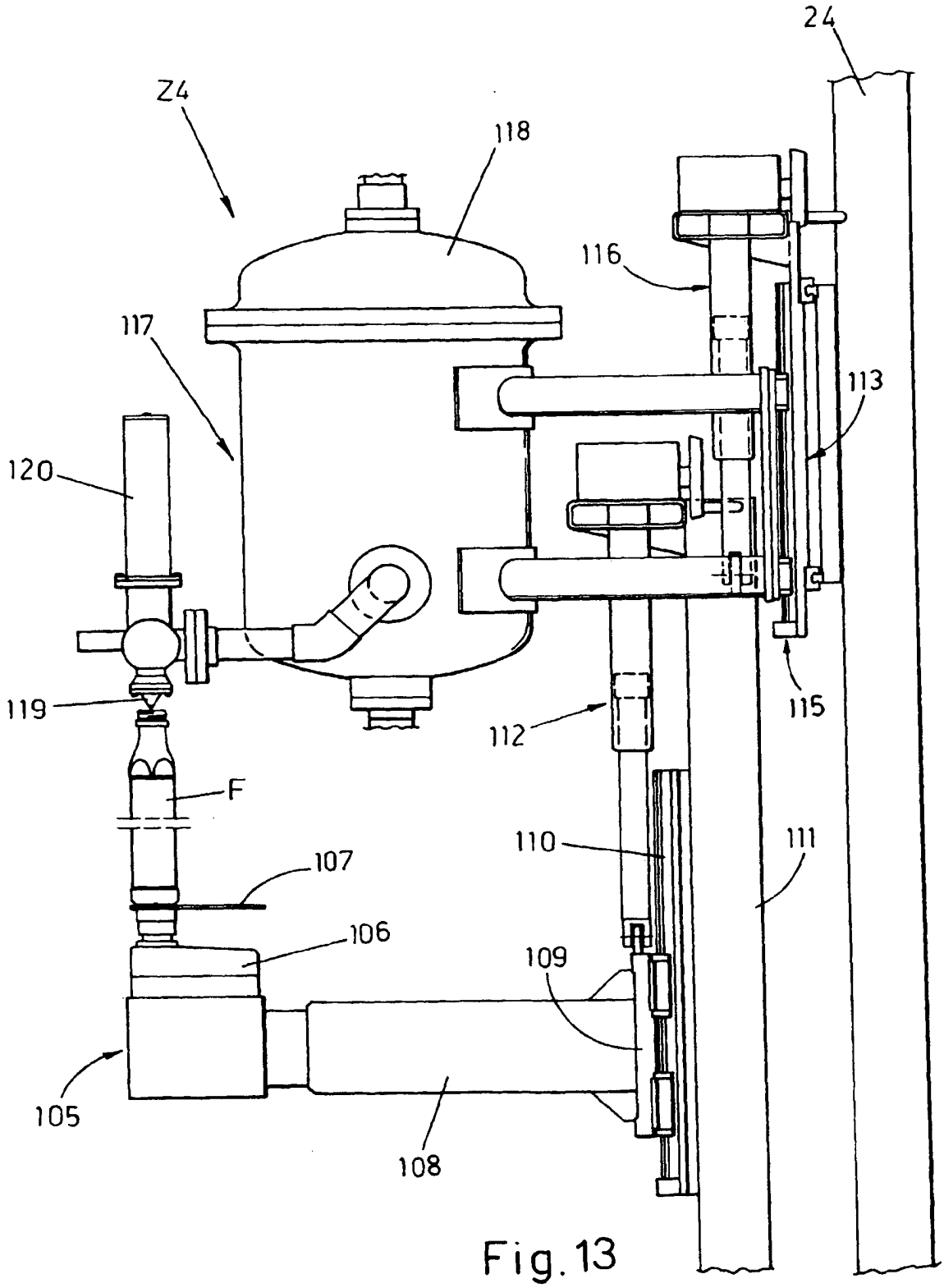
24
Z4
118
116
117
113
120
119
115
112
F
110
111
107
106
109
105
108

Fig.13

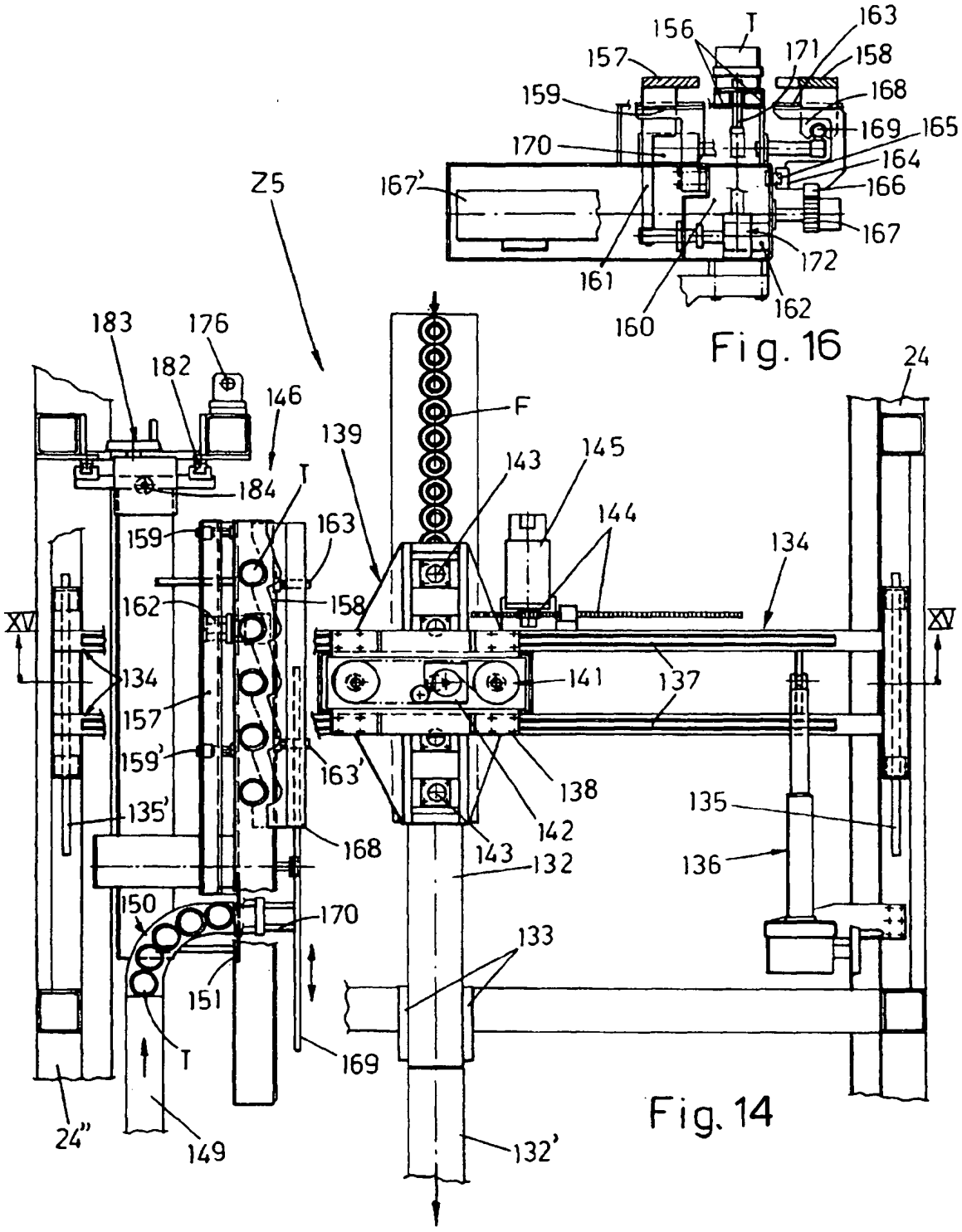
156
T
163
157
171
158
159
168
169
165
170
164
Z5
167'
166
167
172
161
162
160
183
176
182
146
24
F
139
143
145
184
T
144
159
163
134
162
158
XV
XV
134
141
137
157
159'
163'
138
135'
135
142
168
143
132
136
150
170
133
151
T
169
24"
149
132'

Fig. 16

Fig. 14

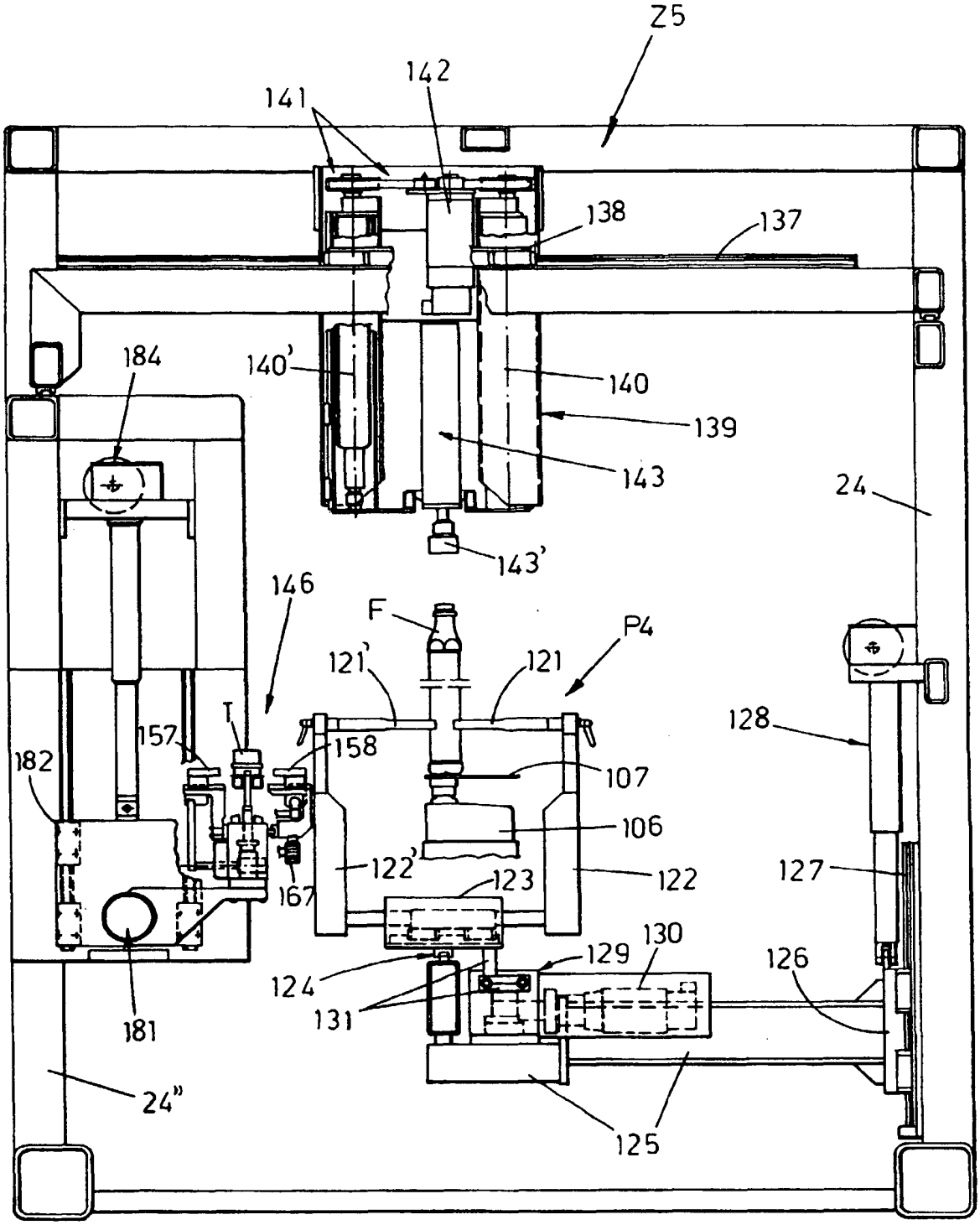
Z5
142
141
138
137
184
140'
140
139
143
24
143'
146
F
P4
121'
121
128
157
158
182
107
106
122'
123
122
127
167
130
129
126
124
131
181
24"
125

Fig. 15